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ESTIMATION OF THE SEA SURFACE'S TWO-SCALE BACKSCATTER PARAMETERS

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ABSTRACT

The relationship between the sea-surface normalized radar cross section and the friction velocity vector is determined using a parametric two-scale scattering model. The model parameters are found from a non-linear maximum likelihood estimation. The estimation is based on the AAFE aircraft scatterometer measurements and the sea-surface anemometer measurements collected during the JONSWAP '75 experiment. The estimates of the ten model parameters converge to realistic values that are in good agreement with the available oceanographic data. The rms discrepancy between the model and the cross section measurements is 0.7 dB, which is the rms sum of a 0.3 dB average measurement error and a 0.6 dB modeling error.

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Introduction

Satellite microwave scatterometers offer a unique opportunity to gather high-quality, real-time data on the wind field over the world's oceans. The scatterometer directly measures the normalized radar cross section (NRCS) of the sea surface. The correlation between the NRCS and the surface wind vector has long been known [Skolnik, 1970]. However, until recently the lack of accurate NRCS measurements for a variety of viewing angles and wind-sea states has prohibited the quantification of this correlation. The data collected during the NASA Langley Research Center's Advance Application Flight Experiment (AAFE) [Jones, Schroeder, and Mitchell, 1978] now provides the means to precisely determine this correlation.

In this report, a maximum likelihood estimation technique in conjunction with a two-scale scattering model is used to determine the relationship between the NRCS and the surface wind vector. The surface wind vector is expressed in terms of a friction velocity vector $\vec{U}_*$ pointing in the upwind direction. The vector formulation for the two-scale scattering model is presented in the first section. The formulation contains two distributions that characterize the sea-surface roughness. These are the slope probability density function (pdf) for the large-scale sea waves and the wavenumber spectrum for the small-scale waves. The large-scale (small-scale) waves are those having wavelengths greater (smaller) than the radiation wavelength. In the second section the distributions are expressed in parametric form, with the model parameters being directly related to oceanographic observables. The non-linear maximum likelihood estimation of the model parameters is described in the third section. The estimation is based on the AAFE aircraft scatterometer measurements and the sea-surface anemometer measurements collected during the JONSWAP '75 experiment. The last section contains the results of the estimation and the conclusions. Appendix A contains computer printer plots showing both the NRCS measured during the JONSWAP '75 experiment and the NRCS computed from the model. Tables of the NRCS versus friction velocity, incidence angle, relative azimuth angle, and polarization appear in Appendix B. A list of symbols and abbreviations is given in Appendix C.

The results are very encouraging. Ten model parameters are estimated, and in all cases the estimates, which are not constrained by a priori information, converge to realistic values that are in good agreement with the available oceanographic data. The rms discrepancy between the model NRCS and the 1491 JONSWAP '75 measurements is 0.7 dB, which is the rms sum of a 0.3 dB average measurement error and a 0.6 dB modeling error.

The Geometric Optics NRCS and the Bragg NRCS for Backscattering

The NRCS model is based on the two-scale scattering theory. In particular, the footprint of the incident radiation is segmented into regions having dimensions large compared to the radiation wavelength. These regions will in general be tilted with respect to the mean surface across the footprint. A tilt probability is assigned, and the overall NRCS is found by integrating over the regional NRCS weighted by the tilt probability and a geometric factor necessary to ensure energy conservation. Furthermore, the NRCS for a particular region depends upon the wavenumber spectrum of the sea-surface roughness within the region. This dependence is due to Bragg scattering by sea waves having wavenumbers similar to the radiation wavenumber.

The formulas for the bistatic NRCS are given by Wentz [1977]. We now consider the special case of backscattering in which the radiation is scattered back towards the source. In terms of the incident and scattered propagation unit vectors, $\vec{k}_i$ and $\vec{k}_s$, this special case is specified by

$$\vec{k}_s = -\vec{k}_i \tag{1}$$

Under condition (1) the bistatic formulas for the NRCS take the form

$$\sigma^o(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) = \sigma^o_g(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) + \sigma^o_b(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) \tag{2}$$

The two terms represent the geometric-optics NRCS and the Bragg NRCS. Vectors $\vec{E}_i$ and $\vec{E}_s$ are the incident and scattered polarization unit vectors; and $\vec{N}$ is the unit normal to the mean sea surface subtended by the radar footprint.

The geometric optics NRCS is

$$\sigma_g^o(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) = \pi(-\vec{k}_i\cdot\vec{N})^{-1} \; P_n(-\vec{k}_i) \;\; S_g(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;-\vec{k}_i) \tag{3}$$

where $P_n(-\vec{k}_i)$ is the probability density function (pdf) for the regional surface normal unit vector $\vec{n}$ evaluated at $\vec{n} = -\vec{k}_i$. The scattering function $S_g(\cdots)$ is a modification of the Fresnel power reflection coefficient for normal incidence and accounts for the reduction in reflected power due to Bragg scattering. It is a product of second order perturbation theory and hence is a complicated function to compute. In order to simplify the treatment, we do not directly compute it but rather let it be an additional parameter, denoted by R, to be estimated from experimental data. The shadowing function is not included in (3) nor in the subsequent equations because it is essentially unity for the incidence angles out to 70°.

The Bragg NRCS is

$$\sigma_b^o(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) = \int_{4\pi} d\vec{n} \; P_n(\vec{n}) \; G(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{n}) \tag{4}$$

$$G(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{n}) = 16\pi k^4 \; u(-\vec{k}_i\cdot\vec{n})(\vec{n}\cdot\vec{N})^{-1}(-\vec{k}_i\cdot\vec{n})^4 F(\vec{\kappa}_b,\vec{n}) \;\; S_b(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{n}) \tag{5}$$

where the integral is over all differential solid angles $d\vec{n}$. The quantity k is the radiation wavenumber and $u(\cdots)$ is the unit step function. The wavenumber spectrum of the sea-surface roughness within a region having a normal $\vec{n}$ is denoted by $F(\vec{\kappa}_b,\vec{n})$, with $\vec{\kappa}_b$ being the Bragg vector wavenumber.

$$\vec{\kappa}_b = 2k \;\; [(\vec{n}\cdot\vec{k}_i)\vec{n} - \vec{k}_i] \tag{6}$$

The magnitude κ_b of $\vec{\kappa}_b$ is

$$\kappa_b = 2k\,[1 - (\vec{n}\cdot\vec{k}_i)^2]^{\frac{1}{2}} \tag{7}$$

The wavenumber spectrum is normalized such that its integral over all vector wavenumbers is equal to the mean squared elevation variation. The remaining term in (5) is the Bragg scattering function and is given by the following expressions:

$$S_b(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{n}) = |(\vec{E}_i\cdot\vec{e}_v)\ (\vec{E}_s^*\cdot\vec{e}_v)\ \alpha_{vv}^b - (\vec{E}_i\cdot\vec{e}_h)\ (\vec{E}_s^*\cdot\vec{e}_h)\ \alpha_{hh}^b|^2 \tag{8}$$

$$\alpha_{hh}^b = (1 - \varepsilon)/[\cos\Theta_i + (\varepsilon - \sin^2\Theta_i)^{\frac{1}{2}}]^2 \tag{9}$$

$$\alpha_{vv}^b = (\varepsilon - 1)(\varepsilon \sin^2\Theta_i + \varepsilon - \sin^2\Theta_i)/[\varepsilon \cos\Theta_i + (\varepsilon - \sin^2\Theta_i)^{\frac{1}{2}}]^2 \tag{10}$$

$$\vec{e}_h = \vec{k}_i x\vec{n}/|\vec{k}_i x\vec{n}| \tag{11}$$

$$\vec{e}_v = \vec{k}_i x\vec{e}_h \tag{12}$$

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where * denotes complex conjugate. The quantity ε is the relative permittivity of the air-sea interface and Θ_i is the angle made by the incident propagation vector and the regional normal.

$$\cos\Theta_i = -\vec{k}_i\cdot\vec{n} \tag{13}$$

For a radiation wavenumber of 2.91 cm^{-1}, the relative permittivity is the complex number (40.1, -39.3) [Porter and Wentz, 1971].

The above equations for the Bragg NRCS are based on the application of perturbation theory to Maxwell's equations [Rice, 1951]. In the case of backscattering, the perturbation theory requires that the radiation wavelength be large compared to the rms elevation variation of that portion of the wavenumber spectrum $F(\vec{\kappa},\vec{n})$ which is responsible for the backscattering, i.e., $\kappa \sim \kappa_b$, where κ is the magnitude of $\vec{\kappa}$. Equation (7) shows that for the case of no tilting when $\vec{n} = \vec{N}$, the Bragg wavenumber is

$$\kappa_b = 2k \sin \theta_i \tag{14}$$

where θ_i is the incidence angle given by

$$\cos \theta_i = -\vec{k}_i \cdot \vec{N} \tag{15}$$

For incidence angles greater than 40^o, calculations show that the capillary waves having a wavenumber similar to κ_b satisfy the small-scale perturbation requirement. However, for small incidence angles the requirement is not met because of the rapid increase in the capillary wave amplitude with decreasing κ_b. Thus the Bragg scattering theory should begin to breakdown at some incidence angle θ_b less than 40^o.

Although the exact nature of the breakdown is not known, the experimental data do show that the NRCS experiences a smooth transition between the Bragg region and the small-angle region where geometric optics scattering dominates. We assume that for angles smaller than θ_b the Bragg scattering mechanism becomes less efficient, and as a result the contribution of the Bragg NRCS to the total NRCS diminishes with decreasing θ_i. In particular, we require that the Bragg NRCS and its first derivative with respect to θ_i go to zero at $\theta_i = 0$. The smooth transition shown by the experimental data indicates that the cutoff to zero is not abrupt, but rather the Bragg NRCS merges with the geometric optics NRCS. In view of this and the above requirements, we choose the following function to represent the Bragg NRCS for $\theta_i < \theta_b$:

$$\sigma_b^o(\vec{k}_i,\vec{E}_i\,;-\vec{k}_i,\vec{E}_s;\vec{N}) = \beta \tan^2\theta_i \exp(-\tau \tan^2\theta_i), \quad \theta_i < \theta_b \tag{16}$$

For $\theta_i \geq \theta_b$ equations (4) through (13) are assumed valid. The coefficients β and τ are fixed by requiring $\sigma_b^o(\cdots)$ and its first derivative with respect to θ_i to be continuous at $\theta_i = \theta_b$.

As the surface roughness increases, the breakdown point θ_b also increases because a larger portion of the wavenumber spectrum violates the small-scale perturbation requirement. We use the total rms regional slope $\overline{S}$ as defined in the next section as an indicator of surface roughness and assume the following relationship holds:

$$\tan \theta_b = t\,\overline{S} \tag{17}$$

where t is a parameter to be estimated from the experimental data. It should be emphasized that (16) and (17) are purely empirical. Other techniques for modeling the Bragg NRCS at small incidence angles were tried, but with less success.

The Two-Scale Roughness Distributions

In the NRCS model the sea-surface roughness is characterized by two distributions: (1) the pdf $P_n(\vec{n})$ for the regional surface normals and (2) the wavenumber spectrum $F(\vec{\kappa},\vec{n})$ for the roughness within a region having a mean normal $\vec{n}$. The pdf $P_n(\vec{n})$ is specified in terms of the pdf $P_s(S_u,S_c)$ for the regional upwind and crosswind slopes, S_u and S_c. The slope pdf is assumed to be a Gaussian [Cox and Munk, 1956] having zero mean, zero correlation, and standard deviations $\overline{S}_u$ and $\overline{S}_c$ for the upwind and crosswind slopes. It is related to the normal pdf by

$$P_n(\vec{n}) = (\vec{n}\cdot\vec{N})^{-3}\, P_s(S_u,S_c) \tag{18}$$

$$S_u = -\vec{n}\cdot\vec{U}_*/[U_*(\vec{n}\cdot\vec{N})] \tag{19}$$

$$S_c = -\vec{n}\cdot\vec{N}\times\vec{U}_*/[U_*(\vec{n}\cdot\vec{N})] \tag{20}$$

The vector $\vec{U}_*$ is the friction velocity vector pointing upwind and U_* is its magnitude in cm/sec. The factor $(\vec{n}\cdot\vec{N})^{-3}$ is the Jacobian relating the differential area $dS_u dS_c$ to the differential solid angle $d\vec{n}$.

The total rms slope $\overline{S} = (\overline{S}_u^2 + \overline{S}_c^2)^{\frac{1}{2}}$ is highly correlated with the friction velocity [Cox and Munk, 1956; Wentz, 1977]. The correlation is assumed to have the form

$$\overline{S} = s_0 + s_1 \log U_* \tag{21}$$

The upwind and crosswind rms slopes are then given by

$$\bar{S}_u = \bar{S}/(1 + \rho^2)^{\frac{1}{2}} \tag{22}$$

$$\bar{S}_c = \rho\bar{S}_u \tag{23}$$

where ρ is the ratio between $\bar{S}_c$ and $\bar{S}_u$. The parameters ρ, s_o, and s_1 are to be estimated from experimental data.

The Bragg NRCS for large incidence angles is given by an integral over $P_n(\vec{n})$, as is shown by (4). In terms of differentials the relationship between $P_n(\vec{n})$ and $P_s(S_u,S_c)$ is

$$d\vec{n}\ P_n(\vec{n}) = dS_u dS_c\ P_s(S_u,S_c) \tag{24}$$

The integral is evaluated by substituting (24) into (4) and then applying the method of steepest descent. This procedure results in the following expression·

$$\sigma_b^0(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) = -G(\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{N}) + \tfrac{1}{2}\sum_{\ell=1}^{4} G[\vec{k}_i,\vec{E}_i;-\vec{k}_i,\vec{E}_s;\vec{n}(S_u^\ell,S_c^\ell)] \tag{25}$$

where $G(\cdots)$ is given by (5) and $\vec{n}(\cdots)$ is the function for calculating the surface normal from the surface slopes.

$$\vec{n}(S_u,S_c) = [-S_u\vec{U}_*/U_* - S_c(\vec{N}\times\vec{U}_*)/U_* + \vec{N}]/(1 + S_u^2 + S_c^2)^{\frac{1}{2}} \tag{26}$$

The set of slopes, $\{S_u^\ell\}$ and $\{S_c^\ell\}$, appearing as arguments in (25) are $\{\bar{S}_u,-\bar{S}_u,0,0\}$ and $\{0,0,\bar{S}_c,-\bar{S}_c\}$ respectively.

The portion of the wavenumber spectrum $F(\vec{\kappa},\vec{n})$ responsible for Bragg backscattering is those wavenumbers that are similar to the radiation wavenumber. The radiation wavenumber for the NRCS measurements to be considered in the next sections is 2.91 cm^{-1}, and hence $F(\vec{\kappa},\vec{n})$ corresponds to the capillary sea wavenumber spectrum. The capillary spectrum exhibits a power law dependence on wavenumber [Mitsuyasu and Honda, 1974]. Furthermore, we assume that the spectrum is symmetric about the projection of the friction velocity vector $\vec{U}_*$ onto the plane orthogonal to $\vec{n}$, and we retain only the zeroth-order and first-order directional harmonics. Under these assumptions the spectrum takes the form

$$F(\vec{\kappa},\vec{n}) = A_m \, (\kappa_m/\kappa)^q \, (1 + A_r \cos 2\Psi) \, (1 + B \, S_u/\bar{S}_u) \tag{27}$$

The leading term A_m is the zeroth-order harmonic of the wavenumber spectrum at the point of minimum phase speed given by $\kappa_m = 3.63$ cm^{-1}. The exponent q is the power law, and A_r is the ratio of the first-order harmonic to the zeroth-order harmonic and is assumed independent of κ. The quantity Ψ is the angle between $\vec{\kappa}$ and the projection of the friction velocity vector $\vec{U}_*$ onto the plane orthogonal to $\vec{n}$.

$$\cos \Psi = \vec{\kappa}\cdot\vec{n}\times(\vec{U}_*\times\vec{n})/[\kappa|\vec{n}\times(\vec{U}_*\times\vec{n})|] \tag{28}$$

The straining of capillary waves by the orbital motion of larger waves is accounted for in (27) by the third term in the parentheses. This term weights the spectrum according to the upwind regional slope S_u. A positive straining coefficient B means that regions on the downwind slope of a large wave have a higher capillary spectrum than regions on the upwind slope.

Wavetank and radar experiments [Mitsuyasu and Honda, 1974; Wentz, 1977] indicate that the capillary amplitude A_m increases approximately as the square of U_*. In view of this the following correlation between A_m and U_* is assumed:

$$\log A_m = a_o + a_1 \log U_* \quad (29)$$

where A_m is in cm^4. The parameters a_o and a_1 along with q, A_r, and B are to be estimated from experimental data.

Maximum Likelihood Estimation of the NRCS Function

The NRCS function defined in the previous two sections contains ten unknown model parameters, which are listed in Table 1 appearing in the next section. The values for these parameters are found using the technique of maximum likelihood estimation. The estimation is based on the aircraft 13.9 GHz scatterometer measurements and the sea-surface anemometer measurements collected during the JONSWAP '75 experiment. The aircraft flew an assortment of straight lines and circles over 36 different wind-sea states. We let σ_{ij} denote the actual synoptic NRCS corresponding to the jth measurement of the ith wind-sea state. The actual synoptic friction velocity and wind direction for the ith wind-sea state are denoted by U_i and χ_i. The usual superscript o on σ and subscript * on U are deleted to abbreviate the notation. The sea-surface NRCS is then

$$\sigma_{ij} = f_{ij}(U_i, \chi_i, \{p\}_\mu) \tag{30}$$

where $f_{ij}(\cdots)$ is the NRCS function discussed in the previous sections. The subscripts ij on f implicitly denote the incident propagation vector, the mean sea-surface normal, and the polarization for the ith,jth measurement. These three parameters are assumed to be exactly known. The elements of the set $\{p\}_\mu$ are the unknown model parameters, where the subscript μ denotes the number of elements in the set and in this case equals 10. Implicit in (30) is the assumption of a perfect model. The effect of the modeling error on the estimation is discussed at the end of this section.

The unknowns that are to be estimated are the model parameters $\{p\}_\mu$, the friction velocities $\{U\}_\nu$, and the wind directions $\{\chi\}_\nu$, where ν

indicates the number of wind-sea states and equals 36. The measurements on which the estimations are to be based are the NRCS measurements $\{\bar{\sigma}\}_\eta$, the friction velocity measurements $\{\bar{U}\}_\nu$, and the wind direction measurements $\{\bar{\chi}\}_\nu$. The number η of the NRCS measurements equals 767 for vertical polarization and 724 for horizontal polarization. The bar is used to denote measured quantities as opposed to their actual values. The total parameter set is then

$$\{x\}_{\mu+2\nu} = \{p\}_\mu + \{U\}_\nu + \{\chi\}_\nu \tag{31}$$

and the total measurement set is

$$\{y\}_{\eta+2\nu} = \{\bar{\sigma}\}_\eta + \{\bar{U}\}_\nu + \{\bar{\chi}\}_\nu \tag{32}$$

For the case being considered the number η of NRCS measurements is much greater than the number μ of model parameters, and hence the estimation system is over-determined.

The most complete statistical description of the unknown parameter set $\{x\}_m$, $m = \mu + 2\nu$, is the conditional probability density that the parameters are within the neighborhood $\{dx\}_m$ of $\{x\}_m$, given the measurement set $\{y\}_n$, $n = \eta + 2\nu$. The probability density is given by the following extension of Bayes' equation:

$$P(\{x\}_m|\{y\}_n) = \frac{P(\{x\}_m)\prod_{\iota=1}^{n} P(y_\iota|\{x\}_m,\{y\}_{\iota-1})}{\int\{dx\}_m\, P(\{x\}_m)\prod_{\iota=1}^{n} P(y_\iota|\{x\}_m,\{y\}_{\iota-1})} \tag{33}$$

The maximum likelihood estimation of the parameter set $\{x\}_m$ is defined as the set for which $P(\{x\}_m|\{y\}_n)$ is a maximum.

Three conditions are imposed to simplify the problem:

1. No a priori information is available on the parameter set; i.e., $P(\{x\}_m)$ is a uniform distribution over $\{x\}_m$ space.

2. The noise from one measurement to the next is uncorrelated; i.e., the probability of measurement y_i depends only on the noise of the ith measurement and on the actual value of the measured quantity.

3. The measurement noise is Gaussian distributed. Chi-square tests indicate that the error structure in the NRCS measurements and in the friction velocity measurements is closer to log-normal than normal. In view of this, the NRCS and the friction velocities are expressed in terms of logarithms for estimation purposes, while the wind directions are expressed in degrees.

Under these three assumptions (33) takes the form

$$P(\{x\}|\{y\}) = \frac{\exp[-g(\{x\},\{y\})]}{\int\{dx\}\exp[-g(\{x\},\{y\})]} \tag{34}$$

$$g(\{x\},\{y\}) = \sum_{i=1}^{\nu}\left\{\frac{(\bar{U}_i - U_i)^2}{2\Delta U_i^2} + \frac{(\bar{X}_i - X_i)^2}{2\Delta X_i^2} + \sum_{j=1}^{\xi_i}\frac{\left[\bar{\sigma}_{ij} - f_{ij}(U_i,X_i,\{p\})\right]^2}{2\Delta\sigma_{ij}^2}\right\} \tag{35}$$

where ΔU_i, $\Delta \chi_i$, and $\Delta\sigma_{ij}$ are the standard deviations (sd) in the friction velocity, wind direction, and NRCS measurements, $\bar{U}_i$, $\bar{X}_i$, and $\bar{\sigma}_{ij}$.

The integer ξ_i is the number of NRCS measurements of the ith wind-sea state. The set subscripts indicating the number of elements are deleted in (35) and in the subsequent equations in order to simplify the notation.

The NRCS function $f_{ij}(\cdots)$ is nonlinear. However, before treating the nonlinear problem, it is instructive to consider the simpler situation in which the function is linear in terms of U_i, X_i, and the model parameters $\{p\}$. In this case $P(\{x\}|\{y\})$ is a multivariate Gaussian distribution. The maximum likelihood estimation of the Ith parameter x_I is the mean value of the parameter, and is given by

$$\langle x_I \rangle = \int \{dx\}\ x_I\ P(\{x\}|\{y\}) \tag{36}$$

It should be noted that the set $\{\langle x \rangle\}$ of mean values is also the set for which $P(\{x\}|\{y\})$ is a maximum. The evaluation of (36) is equivalent to finding the least-squares solution to (35). In particular, we use Householder orthogonal transformations [Bierman, 1977] to solve the least-squares problem and to obtain $\langle x_I \rangle$. This method of orthogonal transformations also yields the covariance C_{IJ} between the parameters x_I and x_J. In terms of probabilities the covariance is

$$C_{IJ} = \int \{dx\}\ (x_I - \langle x_I \rangle)(x_J - \langle x_J \rangle)\ P(\{x\}|\{y\}) \tag{37}$$

The nonlinearity of the model function is treated iteratively by solving for the set of parameters that maximizes $P(\{x\}|\{y\})$. This is accomplished by expanding $f_{ij}(\cdots)$ in a first order Taylor's series about a first-guess set of friction velocities, wind directions, and model parameters. The first guesses for the friction velocities and wind directions are the anemometer measurements, $\{\overline{U}\}$ and $\{\overline{X}\}$. The specification of the first-guess set of model parameters is discussed in the next section. The partial derivatives in the Taylor's series are numerically evaluated as finite differences. This linearized version of the NRCS function is then substituted into (35), and equations (36) and (37) are solved using orthogonal transformations. Another Taylor's series is then constructed with the newly calculated set $\{\langle x \rangle\}$ of mean parameters being the base of the expansion. This procedure is continued until the series of sets $\{\langle x \rangle\}$ converges.

In practice, exact convergence is not achieved because of numerical noise, possibly due in a large part to the use of finite differences. After about 7 iterations the fluctuation in a given parameter from one iteration to the next is of the order of the computed sd for that parameter. Seven more iterations show that these fluctuations have approximately a zero mean. In other words the computed parameter set seems to be confined to within a region in $\{x\}$ space having dimensions of the order of the computed sd. The results discussed in the next section are based on the parameter set and the associated covariances computed after 14 iterations.

The computation of the parameter set and the associated covariances requires that the sd sets $\{\Delta U\}$, $\{\Delta \chi\}$, and $\{\Delta \sigma\}$ be specified. For the first iteration each element of $\{\Delta U\}$ is set to 0.5 dB and each element of $\{\Delta \chi\}$ is set to 10°. These values are typical of the errors inherent in the objective wind field analysis used to specify $\{\overline{U}\}$ and $\{\overline{X}\}$. Each NRCS measurement represents an average of about 5 to 10 independent samples. The sampling error is calculated by dividing the sd of the samples by the square root of the number of samples. These sampling errors, which typically are about 0.3 dB, are then used to specify $\{\Delta \sigma\}$ for the first iteration.

After the first iteration the sd of the differences between all the estimated friction velocities and the measured values is computed. This calculated sd is then used to specify $\{\Delta U\}$ for the next iteration. The set $\{\Delta\chi\}$ is updated in the same way. The procedure is repeated for each iteration. After 14 iterations the friction velocity and wind direction sd converge to values of 0.9 dB and 9°, respectively. These computed sd are in good agreement with the first-guess values of 0.5 dB and 10°.

The updating of the set $\{\Delta\sigma\}$ requires that the modeling error be computed. After the first iteration, we compute the variance of the difference between the measured NRCS $\bar{\sigma}_{ij}$ and the NRCS σ_{ij} computed from the estimated parameters. This computed variance is the sum of two components, one due to measurement errors and the other due to modeling errors, and is given by

$$(1/\eta) \sum_{i=1}^{\nu} \sum_{j=1}^{\xi_i} (\sigma_{ij} - \bar{\sigma}_{ij})^2 = (1/\eta) \sum_{i=1}^{\nu} \sum_{j=1}^{\xi_i} (\Delta\sigma_{ij}^2)_{mea} + (\Delta\sigma_{ij}^2)_{mod} \tag{38}$$

where η is the total number of measurements. The measurement variance $(\Delta\sigma_{ij}^2)_{mea}$ equals the square of the sampling error. The model variance $(\Delta\sigma_{ij}^2)_{mod}$ is found from (38) by assuming that it is constant for each measurement.

$$(\Delta\sigma^2)_{mod} = (1/\eta) \sum_{i=1}^{\nu} \sum_{j=1}^{\xi_i} (\sigma_{ij} - \bar{\sigma}_{ij})^2 - (\Delta\sigma_{ij}^2)_{mea} \tag{39}$$

The variance $\Delta\sigma_{ij}^2$ for the next iteration is then assumed equal to the sum of the measurement variance and the model variance.

$$\Delta\sigma_{ij}^2 = (\Delta\sigma_{ij}^2)_{mea} + (\Delta\sigma^2)_{mod} \quad (40)$$

This procedure is repeated for each iteration. After 14 iterations the sd $(\Delta\sigma)_{mod}$ of the modeling error converges to a value of about 0.6 dB.

Results and Conclusions

As mentioned in the previous section, the non-linear estimation of the model parameters requires an initial, first-guess for the set of parameters. The first guess must be realistic if the estimation technique is to converge. No a priori information on the model parameters is assumed and as a result the parameters are free to vary from the first-guess values.

The initial values that are used appear in Table 1. The power reflection coefficient R is set equal to the Fresnel power reflectivity of sea water for normal incidence. At a wavenumber of 2.91 cm^{-1}, the reflectivity is about 0.61, depending slightly on the water temperature. As a first guess, we assume that the Bragg scattering mechanism begins to break down at incidence angles in the vicinity of 30°. Under this assumption, the breakdown parameter t takes a value of 3. The parameters s_0, s_1, and ρ appearing in the regional slope pdf are initialized to the values derived from Cox and Munk's [1956] sun glitter observations of a clear sea surface. The first guesses for the regression coefficients a_0 and a_1 for the capillary spectrum amplitude are found from Mitsuyasu and Honda's [1974] measurements of the capillary spectrum in a wind-wave channel. The parameter A_r is the ratio of the first-order to the zeroth-order directional harmonic of the wavenumber spectrum. The relationship between A_r and the ratio ρ of the crosswind to the upwind rms slope is

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$$A_r = 2\ (1 - \rho^2)/(1 + \rho^2) \qquad (41)$$

The first guess A_r is found by substituting the first-guess ρ into (41). The capillary spectrum power law q is initialized to Phillips' [1966] value of

TABLE 1. ESTIMATED NRCS MODEL PARAMETERS

Parameters	First Guess	Horizontal Polarization Estimate		Vertical Polarization Estimate	
		Mean	Sd	Mean	Sd
R	0.6090	0.4425	0.0100	0.4095	0.0099
t	3.0000	3.6126	0.1033	3.8253	0.1007
s	0.0492	0.0612	0.0034	0.0540	0.0035
s_1	0.1160	0.0872	0.0026	0.0926	0.0029
ρ	0.8660	0.9661	0.0038	0.9701	0.0044
a_o	-8.4300	-9.3980	0.2954	-10.2008	0.3508
a_1	2.2500	2.8226	0.2079	3.2118	0.2465
A_r	0.2860	0.4649	0.0099	0.6356	0.0077
q	4.0000	4.4970	0.1759	5.3281	0.1671
B	0.0010	0.4932	0.0138	0.2447	0.0217

4 for an idealized capillary spectrum. Because of the lack of information on the straining coefficient B, we simply assign to it a value near zero. That is to say, we initially assume that no straining occurs.

Separate estimates are done for horizontal and vertical polarizations. The parameters are independent of polarization, and hence the estimates for the two polarizations should agree. In general, the agreement is fairly good with the one exception noted below. In Table 1 the estimated mean and standard deviation (sd) for each parameter are listed.

The estimate of the power reflection coefficient R is one third less than the Fresnel power reflectivity. This decrease is in accordance with the two-scale scattering theory, which predicts that the capillary waves scatter power away from the specular direction. The estimate of the parameter t indicates that the Bragg scattering mechanism begins to break down and becomes less efficient for incidence angles ranging from 30° to 40°, depending on and increasing with surface roughness.

The regional slope pdf parameters s_0, s_1, and ρ are in fair agreement with the first-guess values derived from Cox and Munk's sun glitter data. It should be noted that our slope pdf excludes the shorter capillary waves and that Cox and Munk's pdf does not. A noticeable disagreement occurs between Mitsuyasu and Honda's capillary amplitude regression coefficients a_0 and a_1 and the values estimated from the scatterometer measurements. The scatterometer data indicate a steeper increase of capillary wave amplitude with increasing friction velocity. This disagreement is probably due in part to the scatterometer data being limited to calm and moderate wind-sea states. We expect that the inclusion of rougher wind-sea states will tend to flatten the estimated capillary amplitude versus friction velocity relationship. The capillary amplitude derived from the horizontal polarization data is larger than that derived from the vertical polarization data. We feel that the apparent inconsistency is due to wave crests that backscatter horizontal polarized radiation but not vertical polarized radiation [Kalmykov and Pustovoytenko, 1976]. This backscattering adds to the Bragg backscatter, making the capillary amplitude seem larger than it actually is.

The capillary anisotropy ratio A_r is larger than that derived from the Cox and Munk data. It appears as if the short capillary waves are particularly anisotropic. The estimated power law q is greater than the value of 4 for a pure capillary spectrum. The larger value is most likely due to viscous attenuation, which is an important process for the capillary waves being viewed by the scatterometer [Kinsman, 1965]. The estimate of the straining coefficient B has a positive value, and this indicates that the capillary spectrum is higher on the downwind slope of the larger waves. This result is in agreement with Keller and Wright's [1975] wave tank experiment.

Once all the NRCS model parameters have been determined, the NRCS function for a given polarization is expressible in terms of three variables: the friction velocity U_*, the incidence angle θ_i, and the relative azimuth angle ϕ_r between the friction velocity vector $\vec{U}_*$ and the projection of the incident propagation vector $\vec{k}_i$ onto the mean sea surface having a normal $\vec{N}$.

$$\cos \phi_r = \vec{N}\times(\vec{k}_i\times\vec{N})\cdot\vec{U}_*/[|\vec{N}\times(\vec{k}_i\times\vec{N})|U_*] \qquad (42)$$

The NRCS function is then simply denoted $f(\theta_i,\phi_r,U_*)$.

Appendix A contains computer printer plots showing both the NRCS measured during the JONSWAP '75 experiment and the theoretical NRCS computed from $f(\theta_i,\phi_r,U_*)$. For each polarization, 36 different wind-sea states were observed, ranging in friction velocities from 13 cm/sec to 53 cm/sec. The first set of 36 plots is for horizontal polarization, and the second set is for vertical polarization. Each set is ordered according to increasing friction velocity. The plots of the NRCS versus incidence angle correspond to the straight line aircraft flights, and the plots of the NRCS versus azimuth angle correspond to the circle flights. The overall agreement between the measurements and the theory is excellent. The rms discrepancy is 0.7 dB, which is the rms sum of the 0.3 dB measurement sampling error and the 0.6 dB modeling error. We are particularly pleased with how well the model reproduces the upwind-downwind asymmetry in the circle plots. In the model, this asymmetry is due solely to the straining of the capillary waves by the orbital motion of the underlying larger waves. Also, the model closely tracks the experimental data through the incidence angle region from 15° to 30°. This region corresponds to the transition from geometric-optics scattering to Bragg scattering.

The NRCS function $f(\theta_i,\phi_r,U_*)$ is tabulated in Appendix B. Each page corresponds to a particular friction velocity and polarization. The incidence angle θ_i ranges from 0° to 70° in 2° steps. The relative azimuth angle ϕ_r ranges from 0° to 180° in 10° steps. The full 0° to 360° range need not be shown because $f(\theta_i,\phi_r,U_*)$ is an even function of ϕ_r. The range in friction velocity is from 5 cm/sec to 50 cm/sec, in 5 cm/sec steps.

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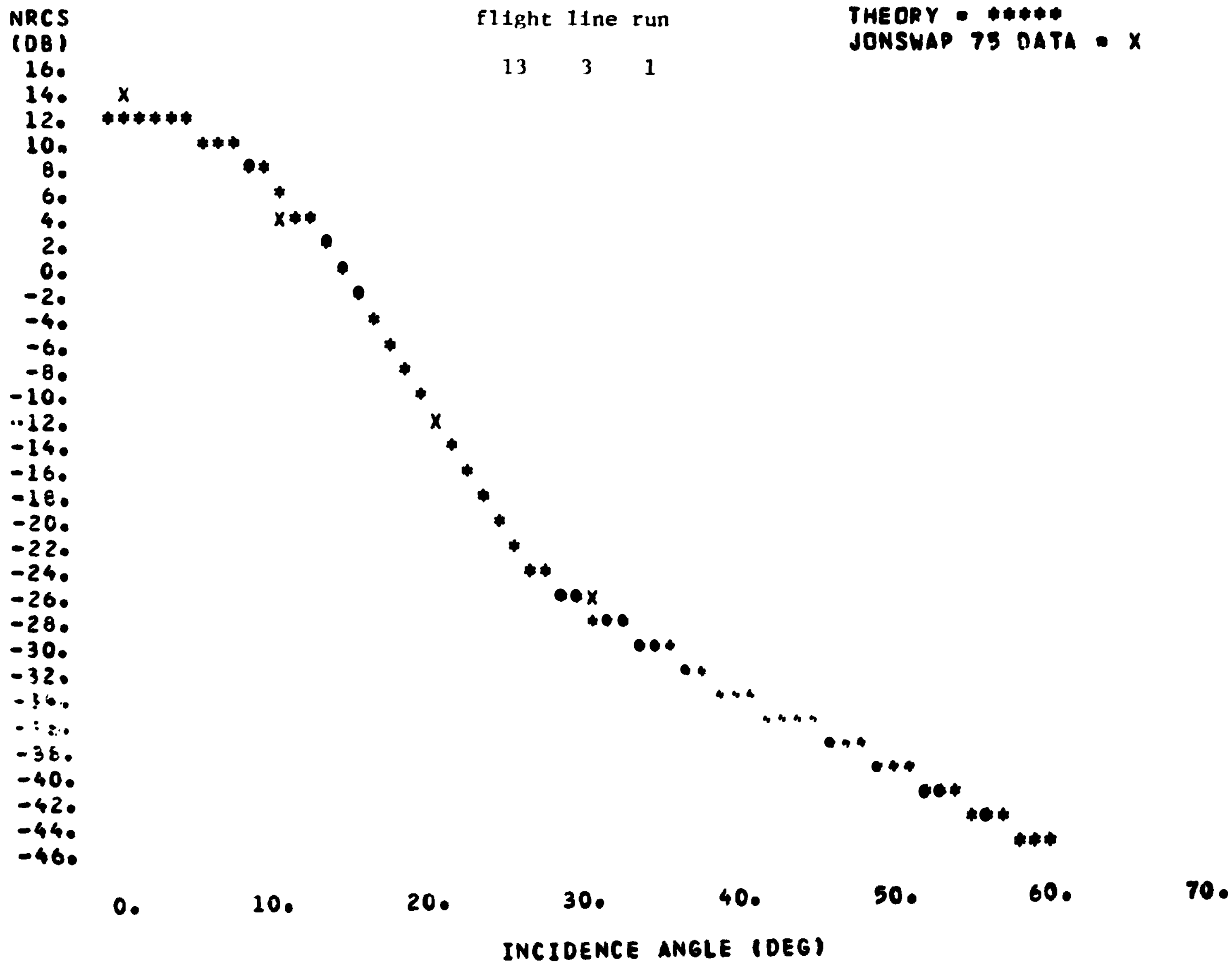
APPENDIX A

Computer Printer Plots of the Theoretical NRCS and The Measured NRCS

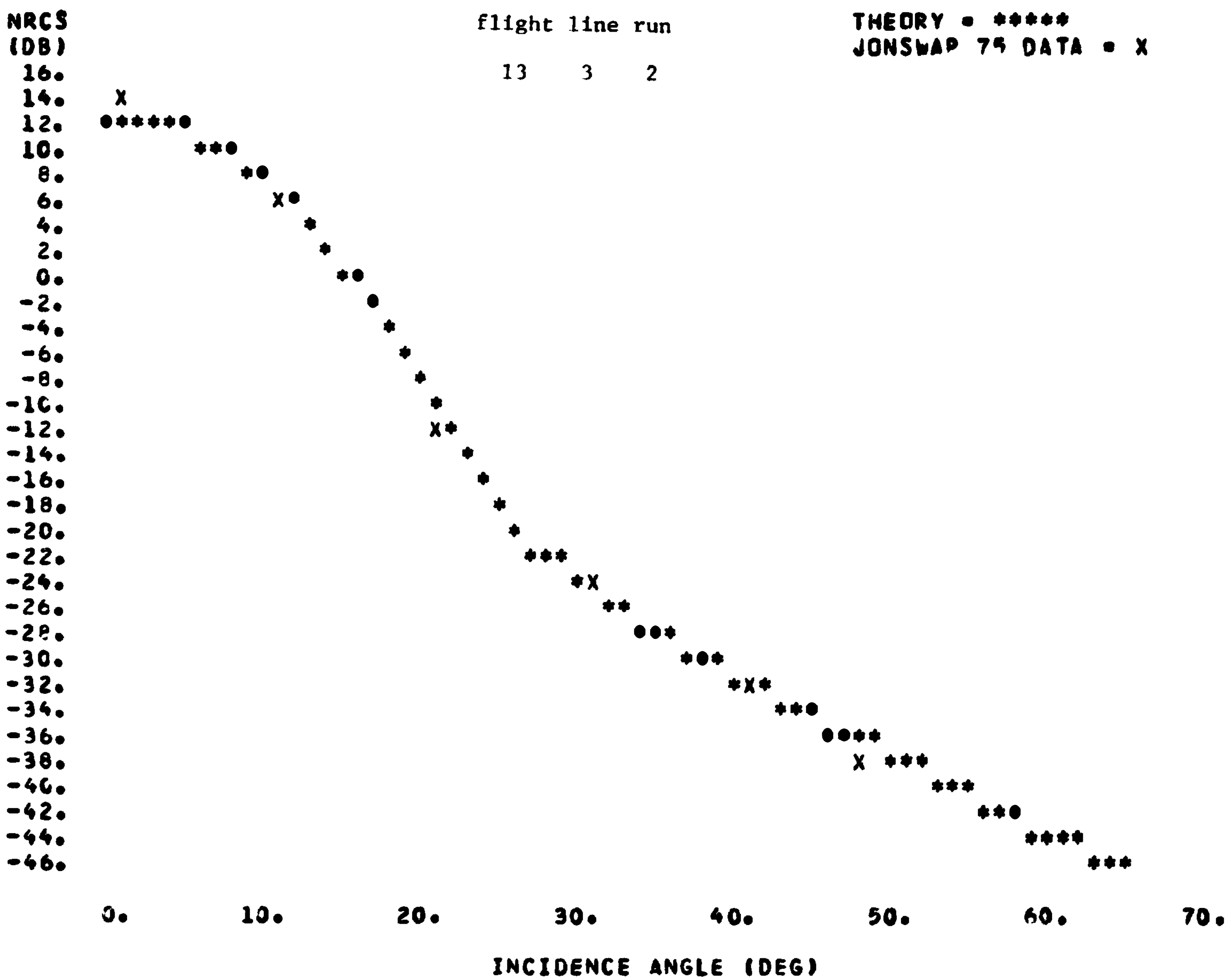
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 13.3 CM/SEC
WIND OUT OF 149. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 113. DEG



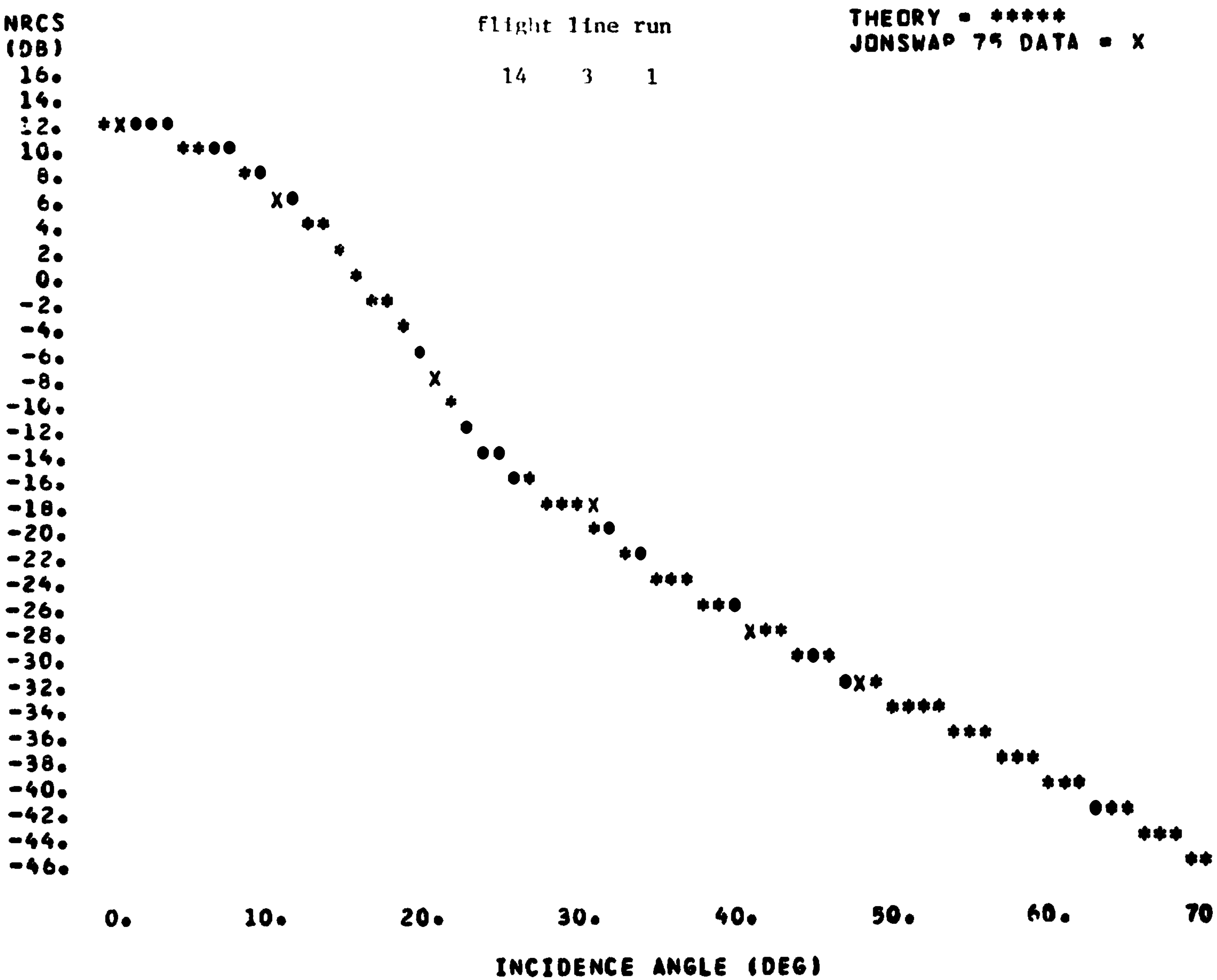
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 14.8 CM/SEC
WIND OUT OF 152. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 63. DEG



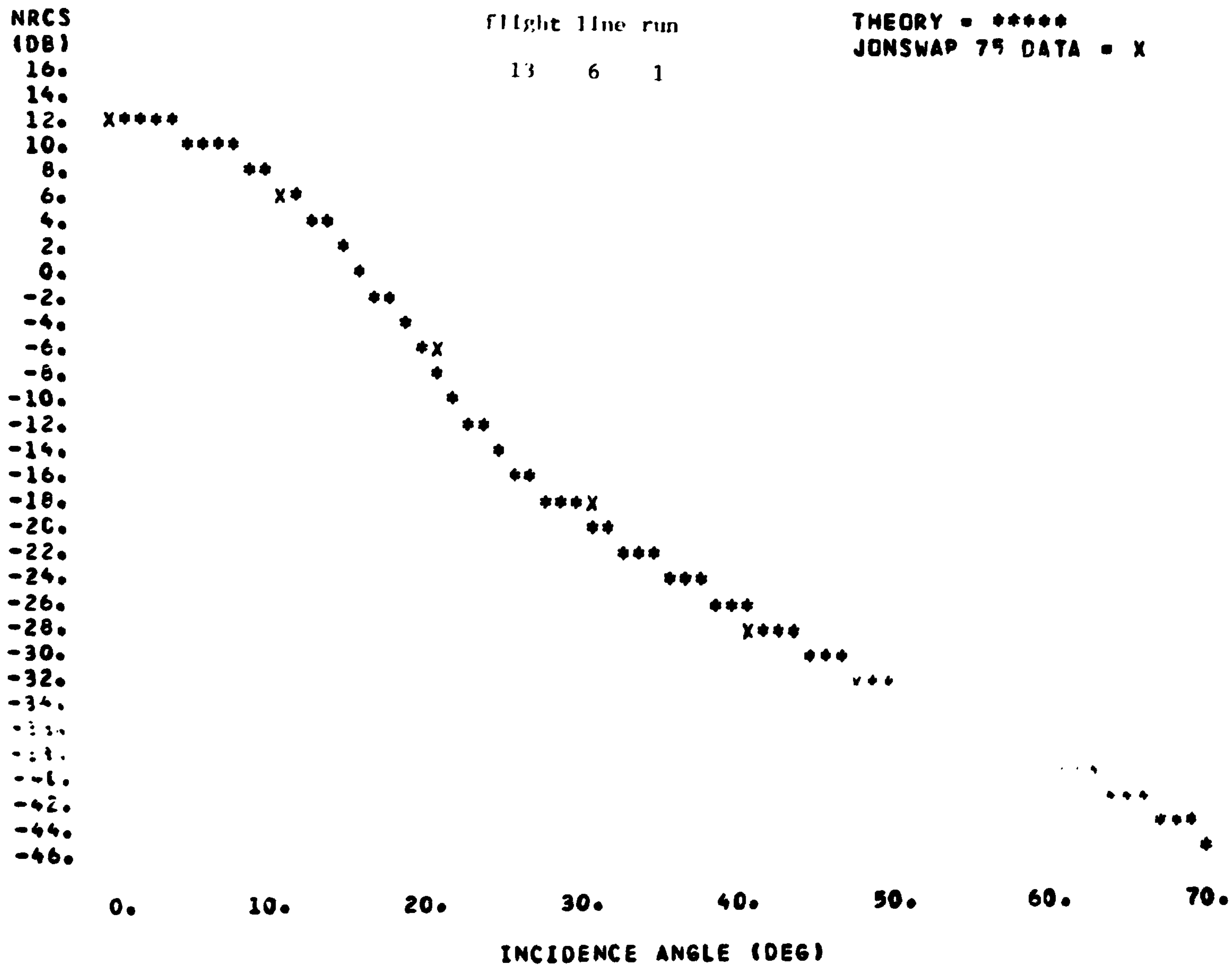
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 15.6 CM/SEC
WIND OUT OF 51. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 10. DEG



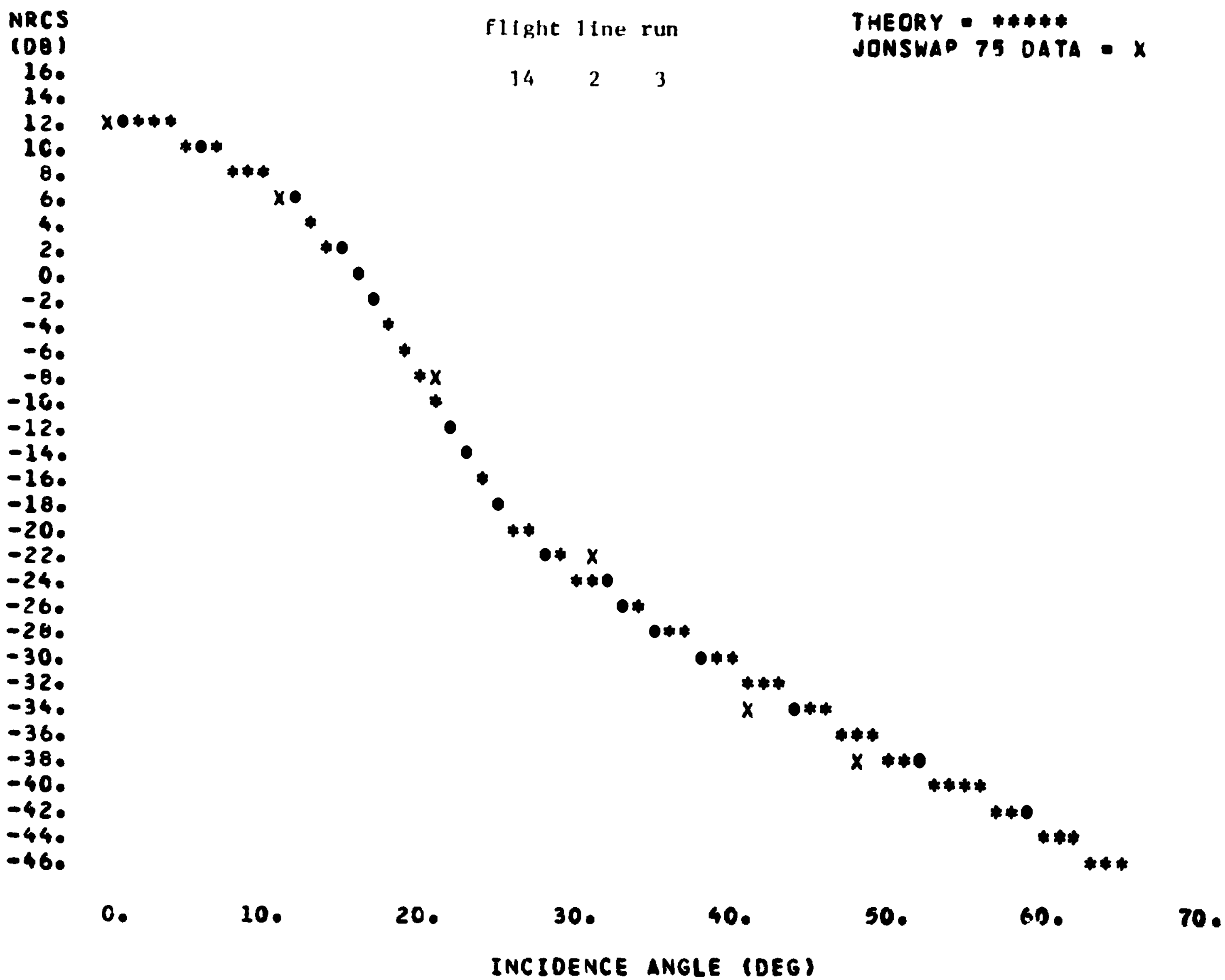
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 16.8 CM/SEC
WIND OUT OF 151. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 22. DEG



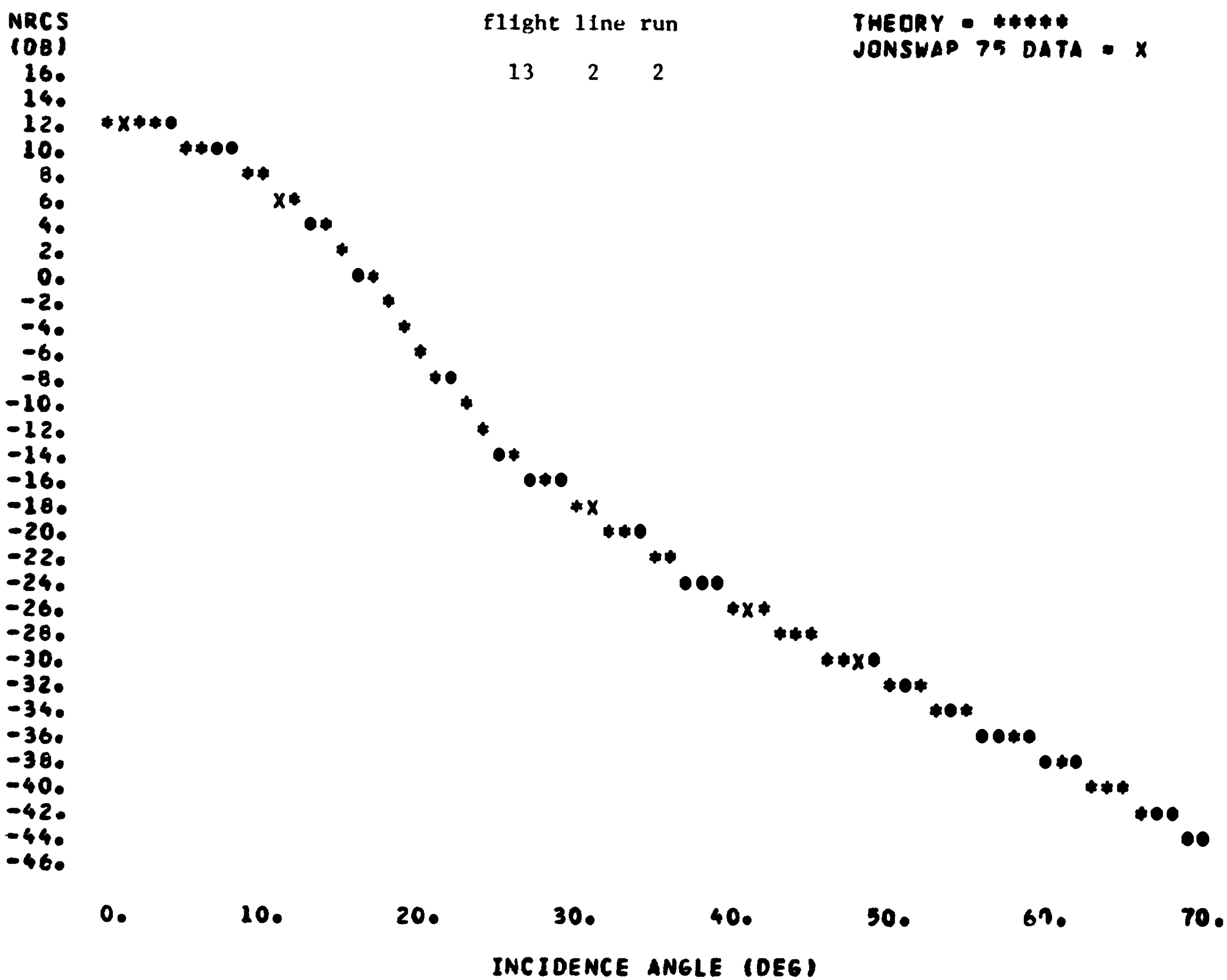
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 17.4 CM/SEC
WIND OUT OF 41. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 90. DEG



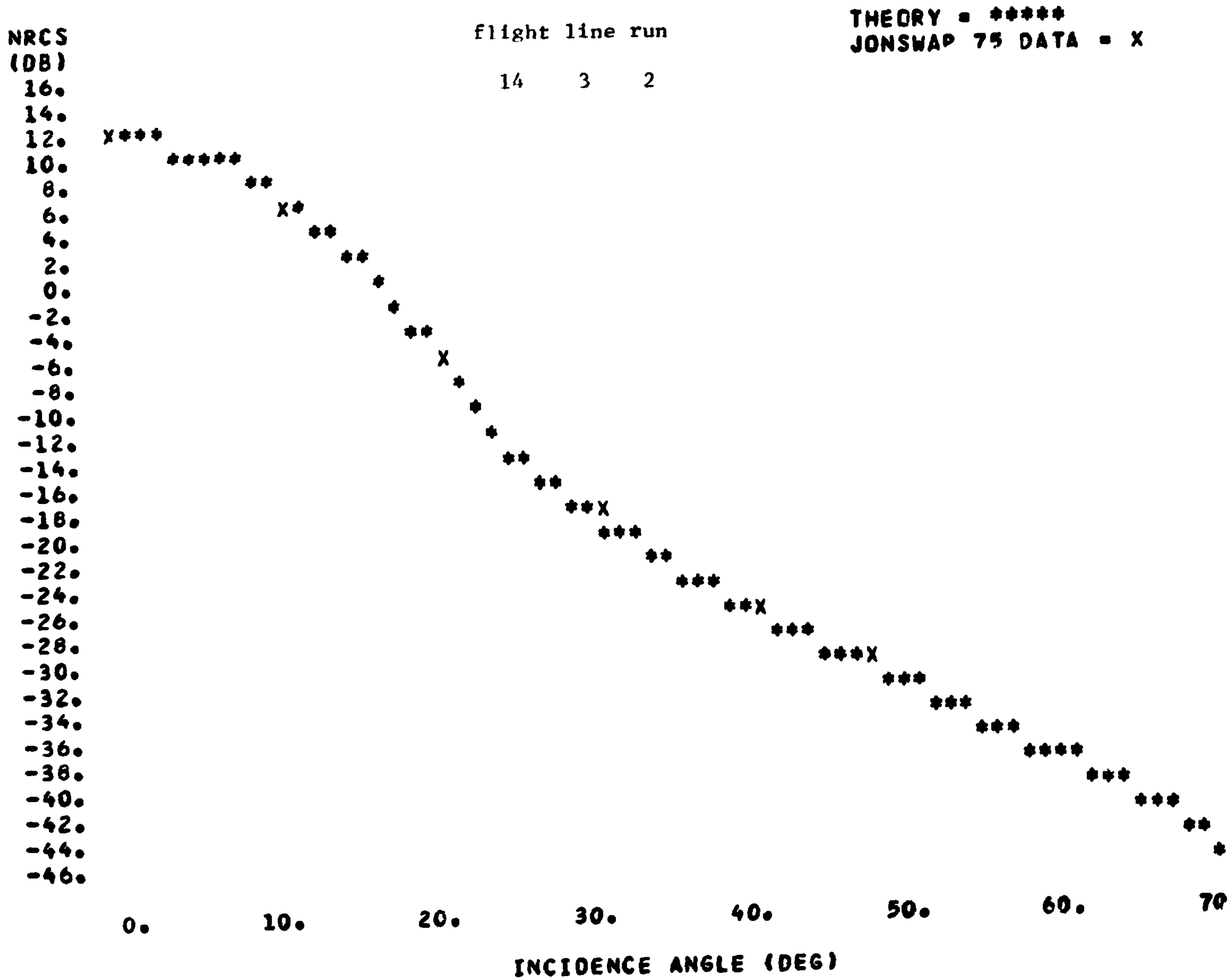
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 18.1 CM/SEC
WIND OUT OF 148. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 20. DEG



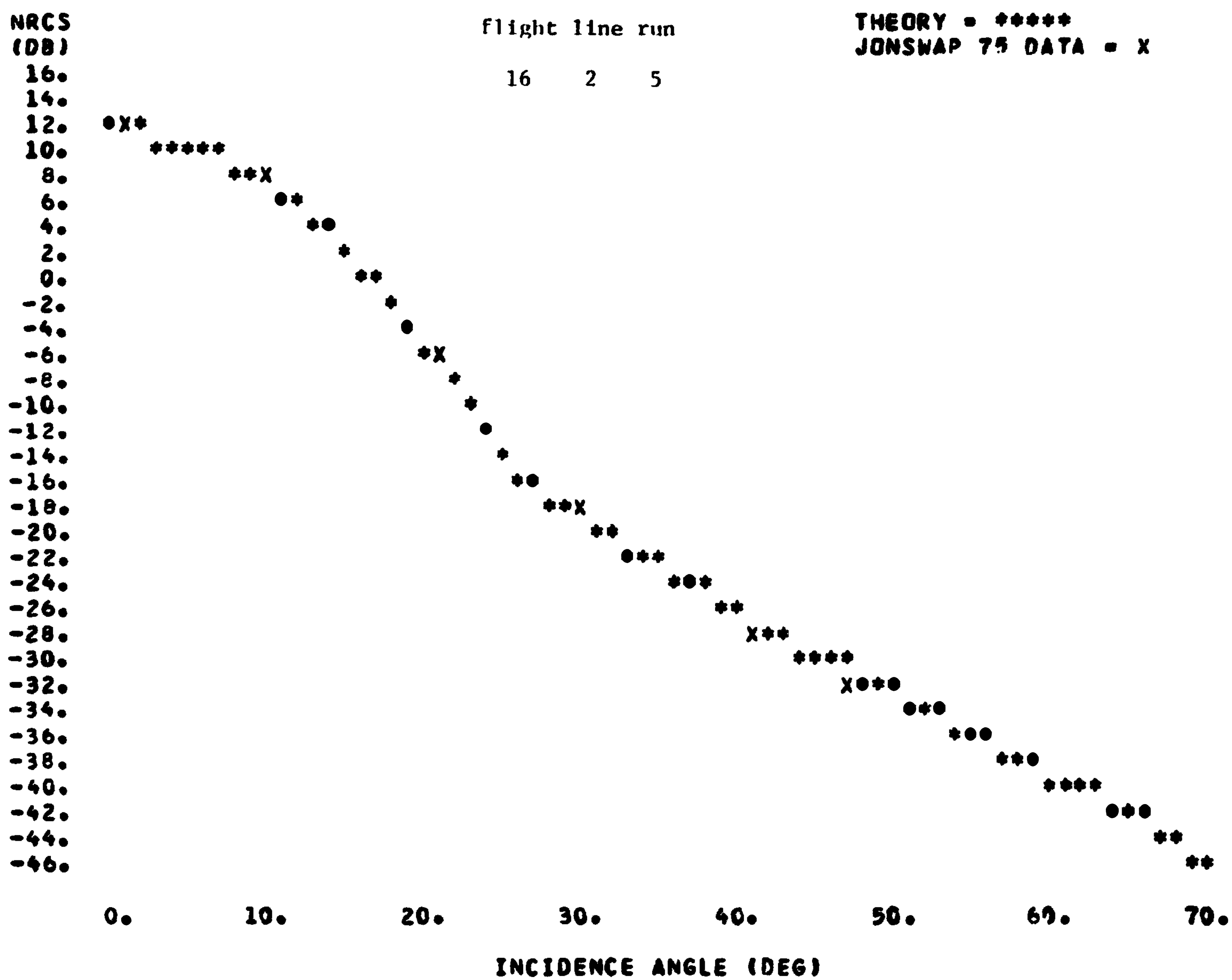
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 21.5 CM/SEC
WIND OUT OF 46. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 175. DEG



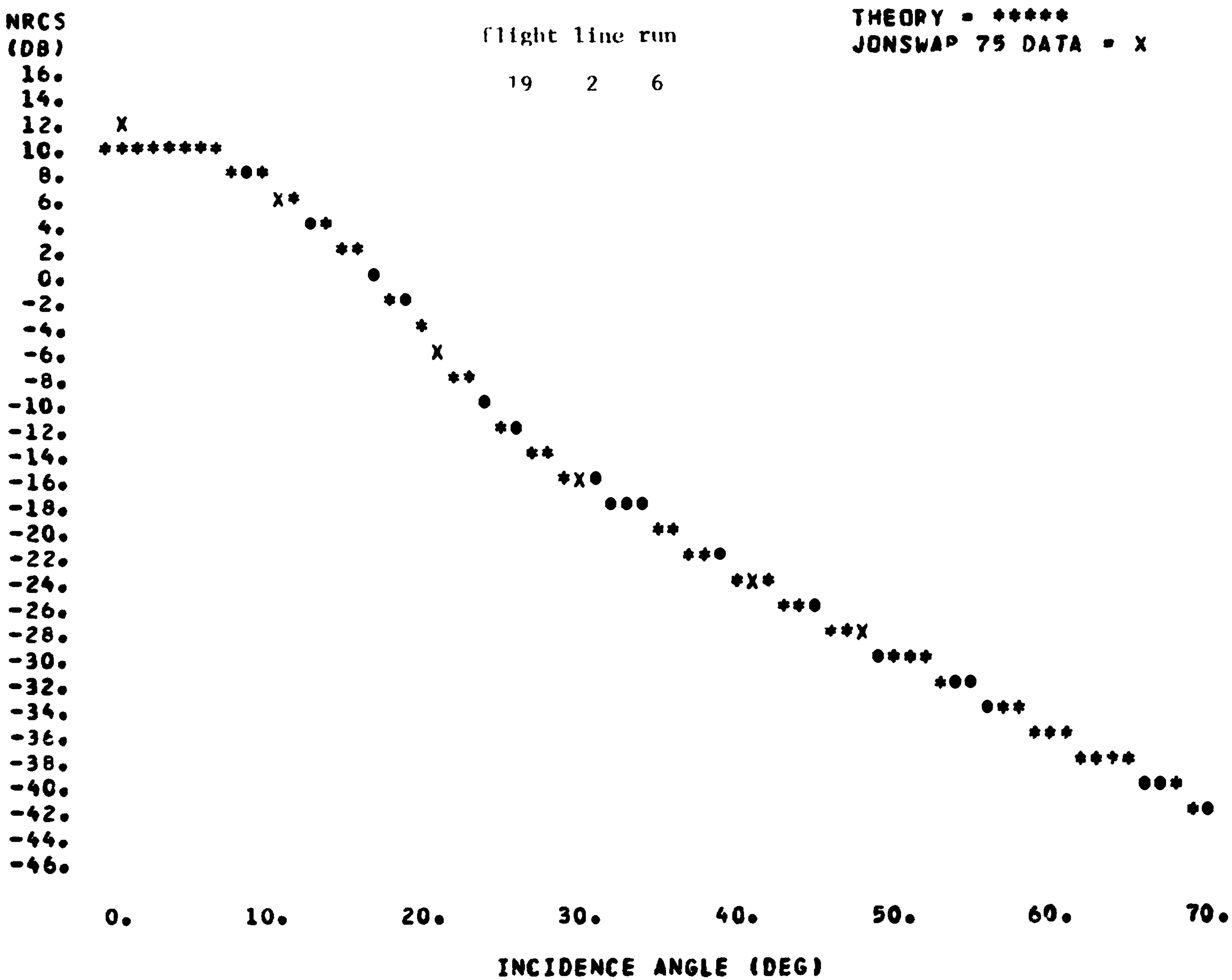
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 24.1 CM/SEC
WIND OUT OF 191. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 103. DEG



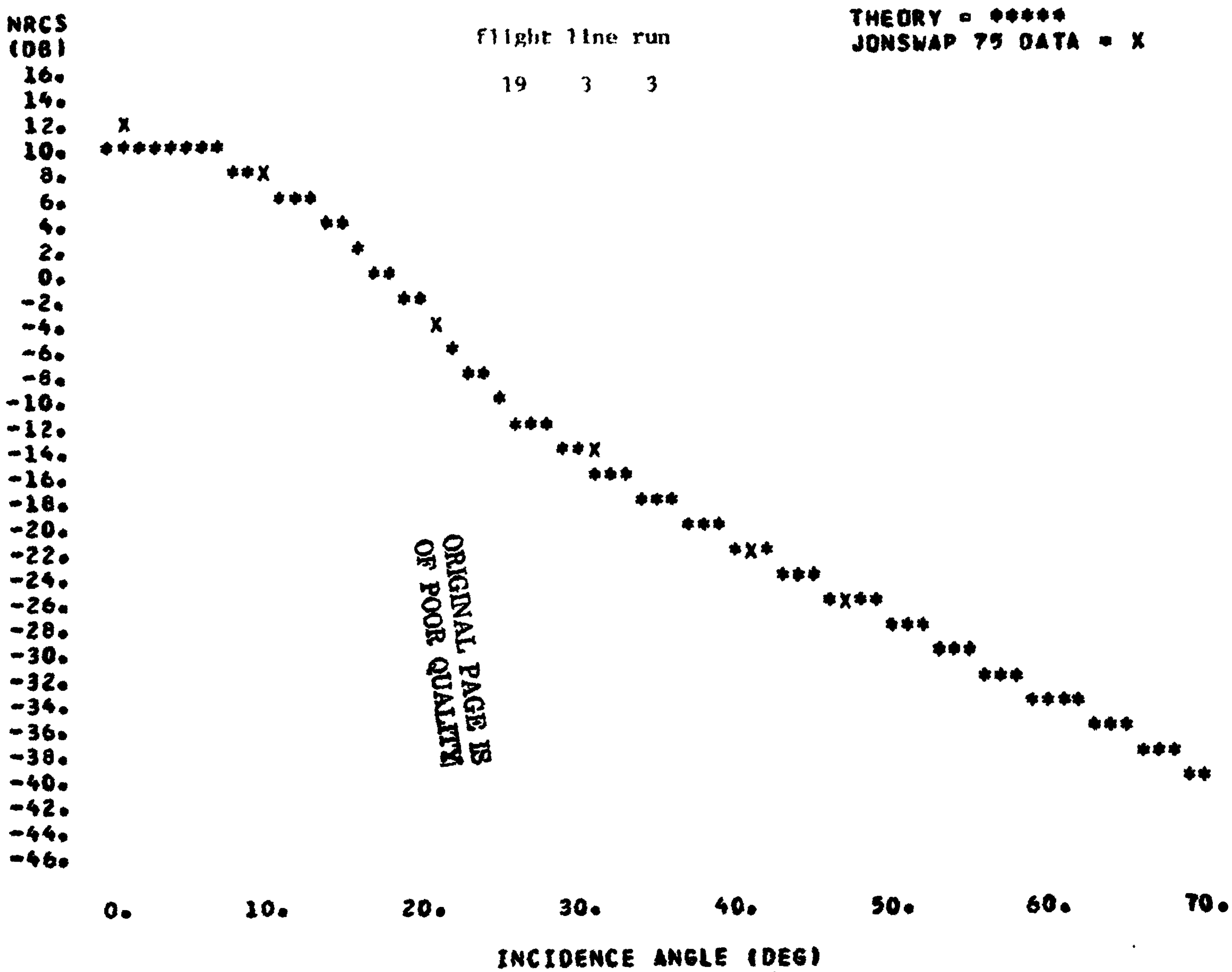
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 29.7 CM/SEC
WIND OUT OF 227. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 77. DEG



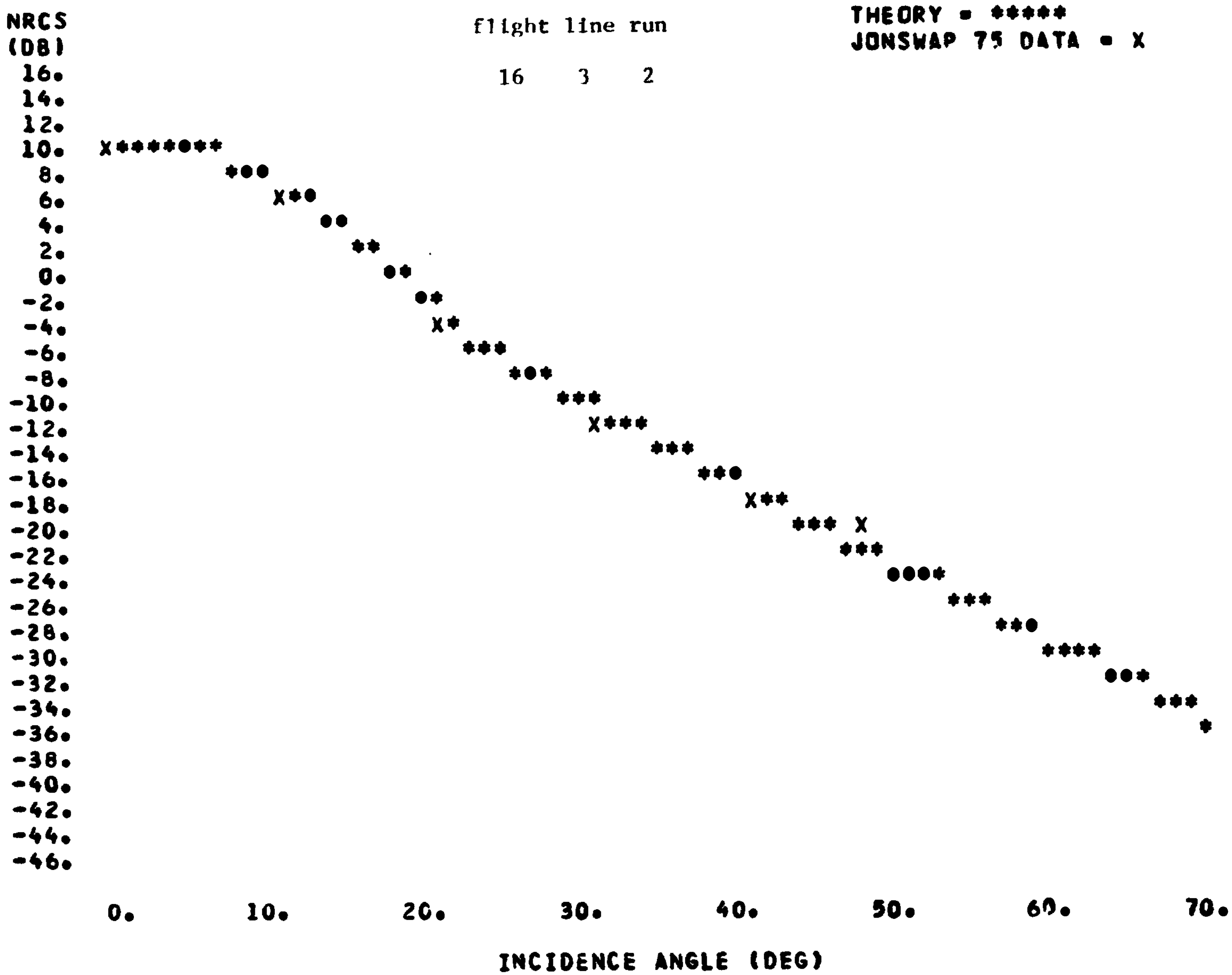
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 30.8 CM/SEC
WIND OUT OF 231. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 167. DEG



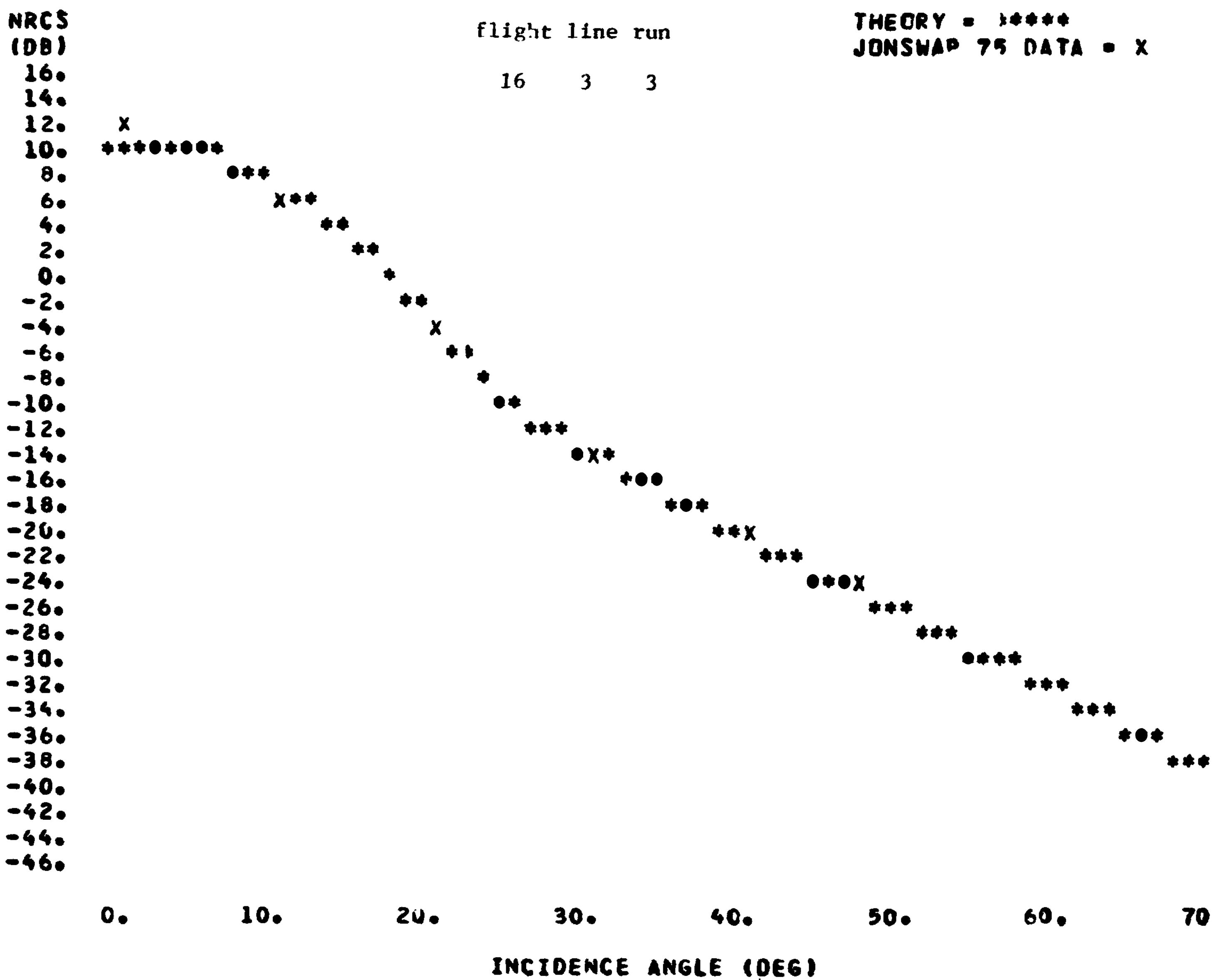
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 34.3 CM/SEC
WIND OUT OF 181. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 21. DEG



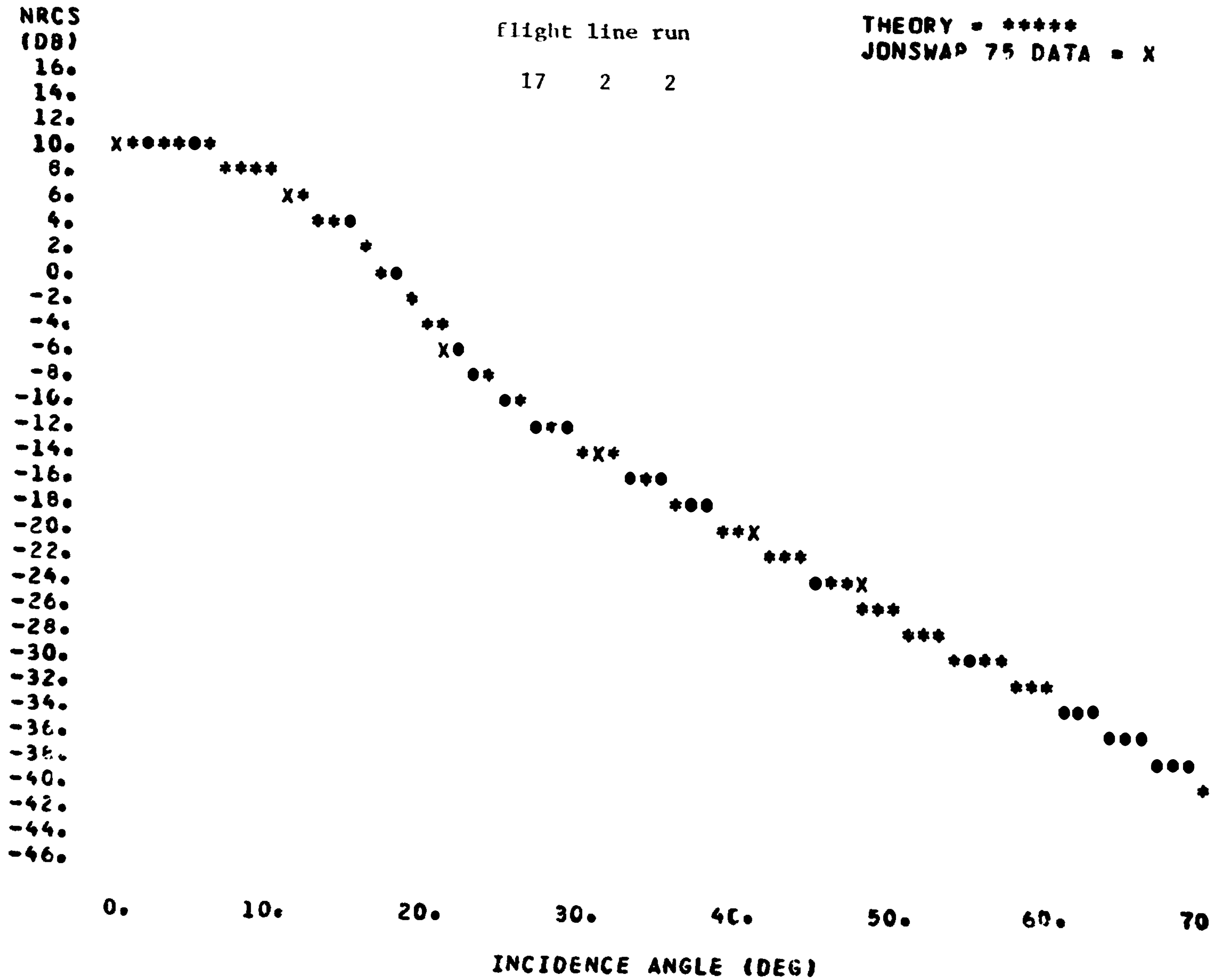
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 35.1 CM/SEC
WIND OUT OF 185. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 153. DEG



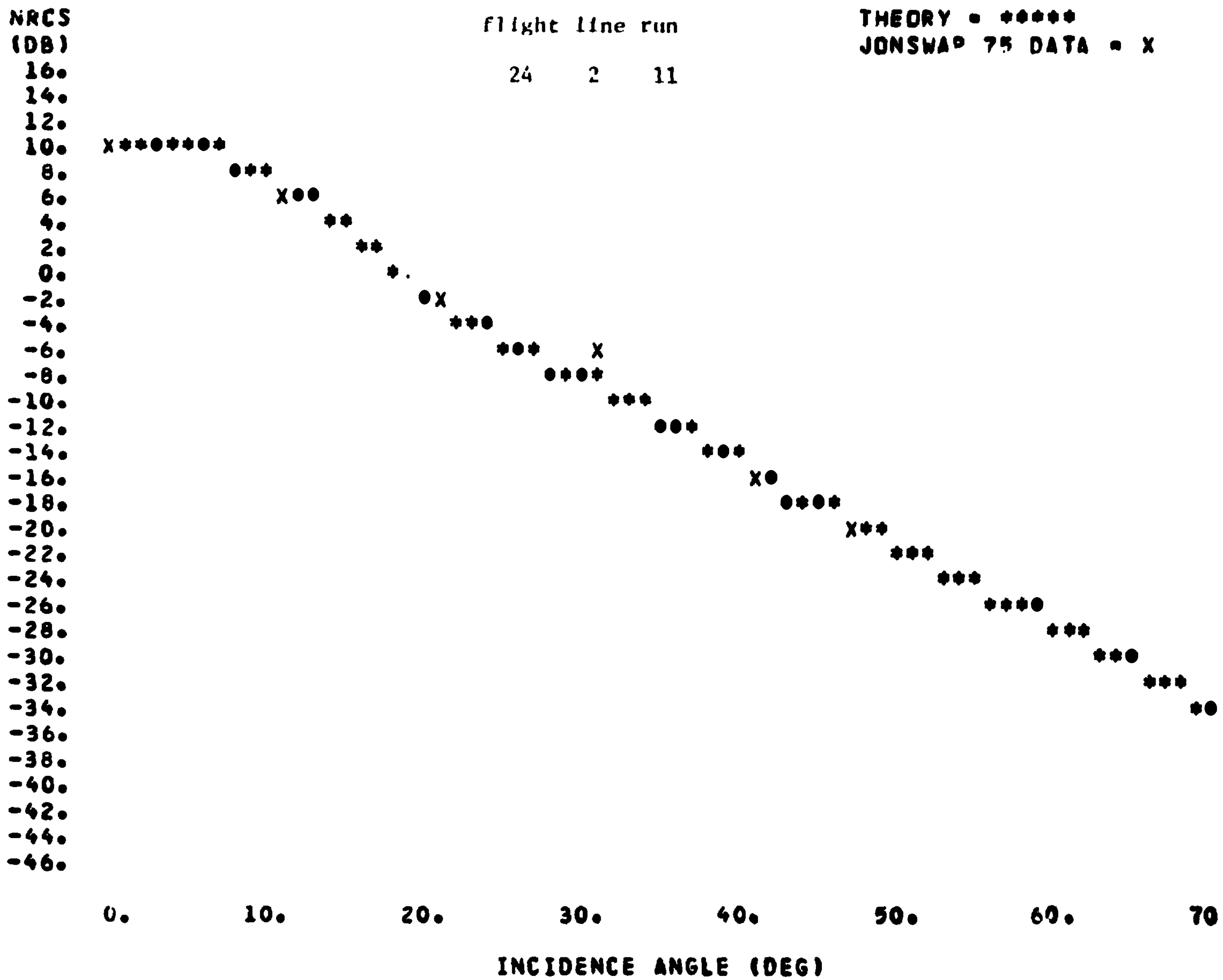
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 35.7 CM/SEC
WIND OUT OF 189. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 69. DEG



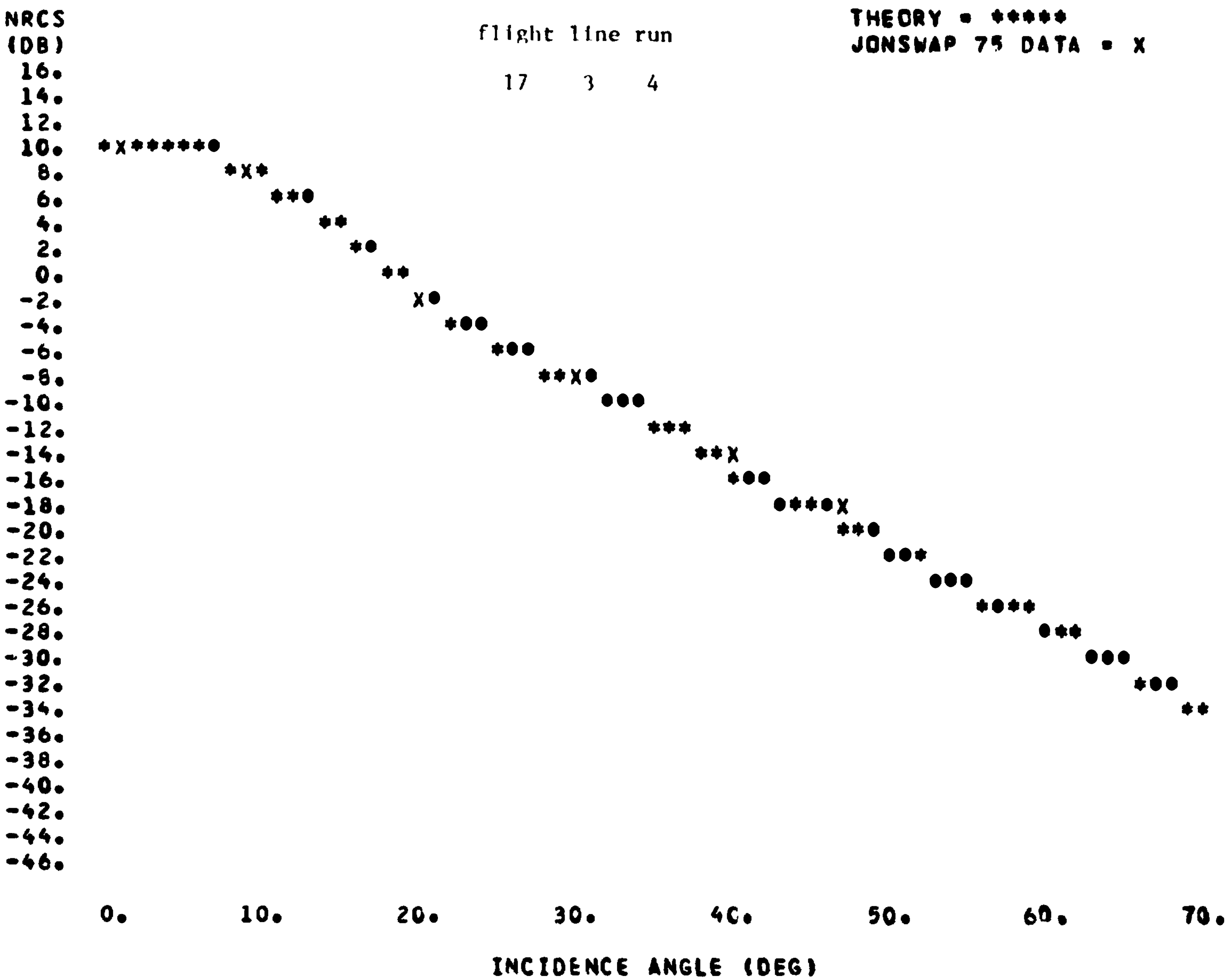
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 37.1 CM/SEC
WIND OUT OF 230. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 0. DEG



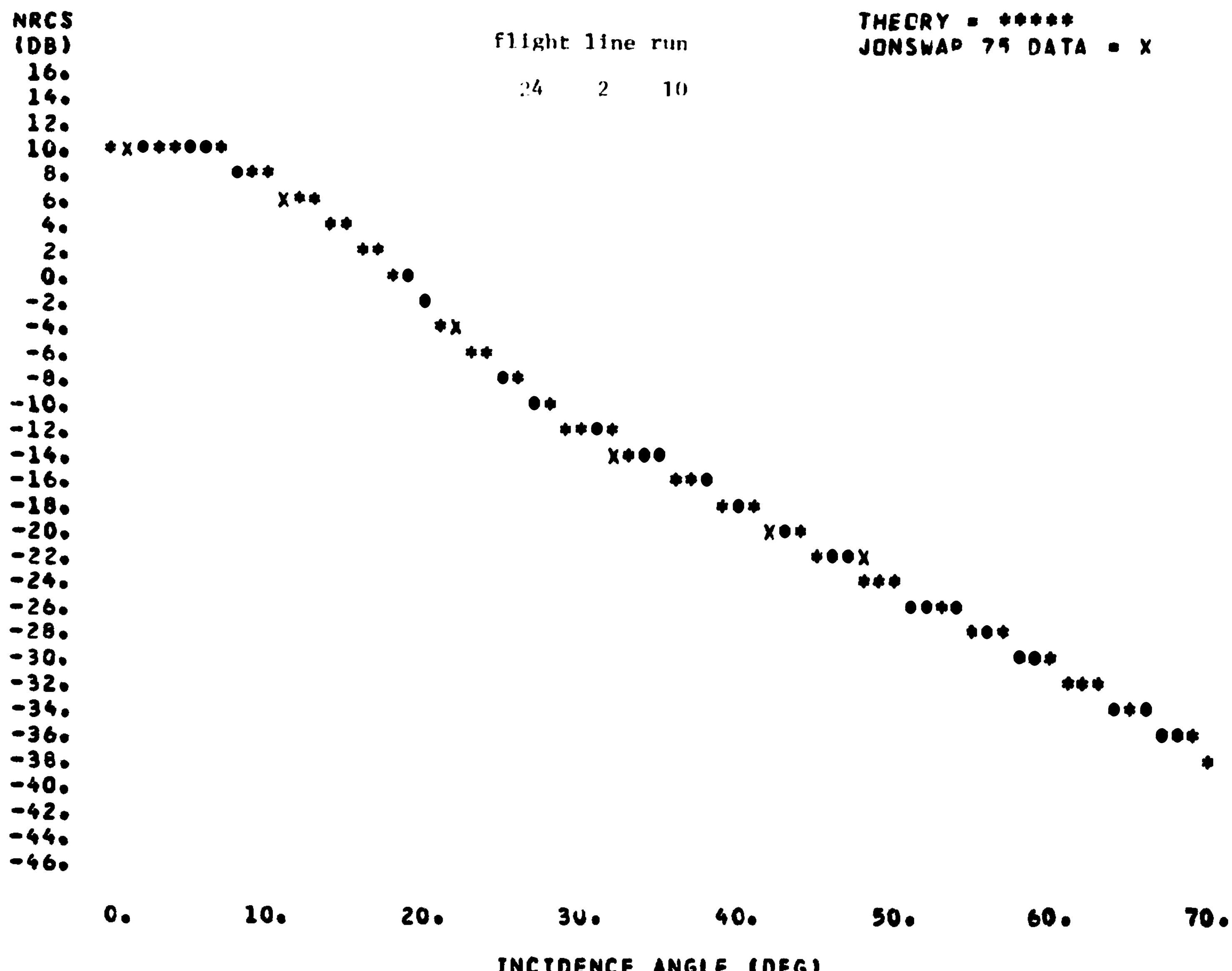
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 38.3 CM/SEC
WIND OUT OF 189. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 17. DEG



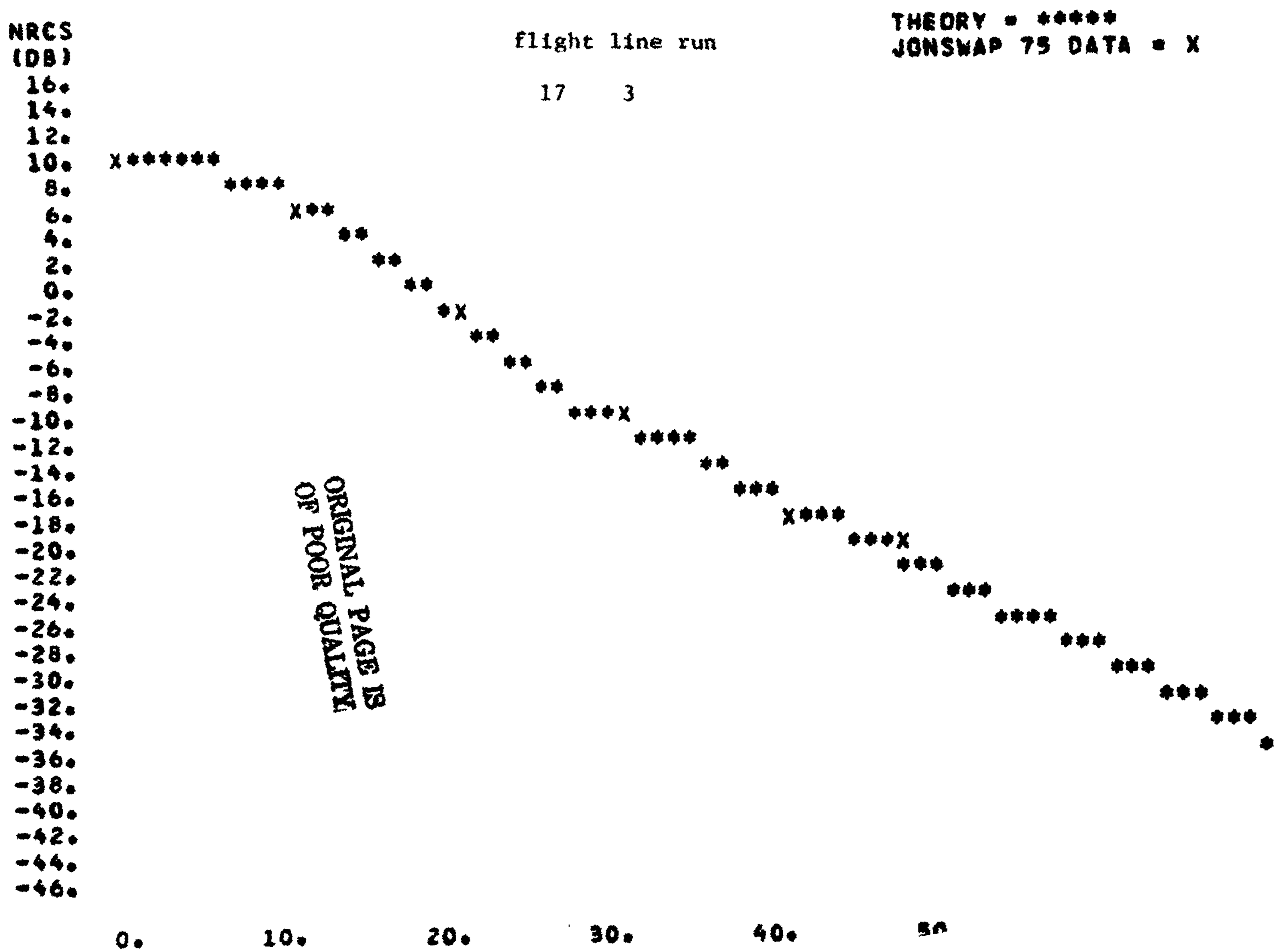
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 38.6 CM/SEC
WIND OUT OF 228. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 176. DEG



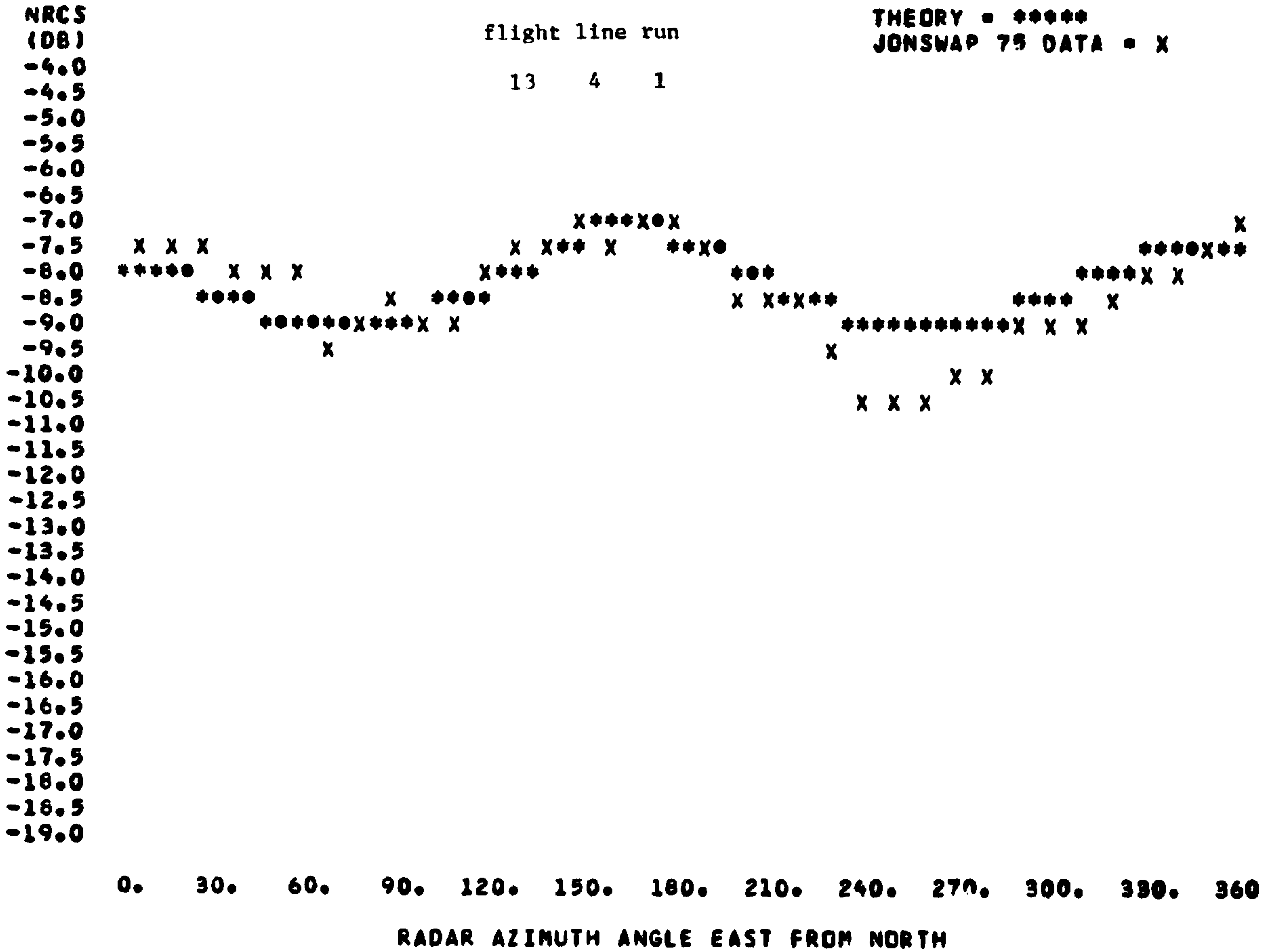
NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 45.2 CM/SEC
WIND OUT OF 191. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 163. DEG



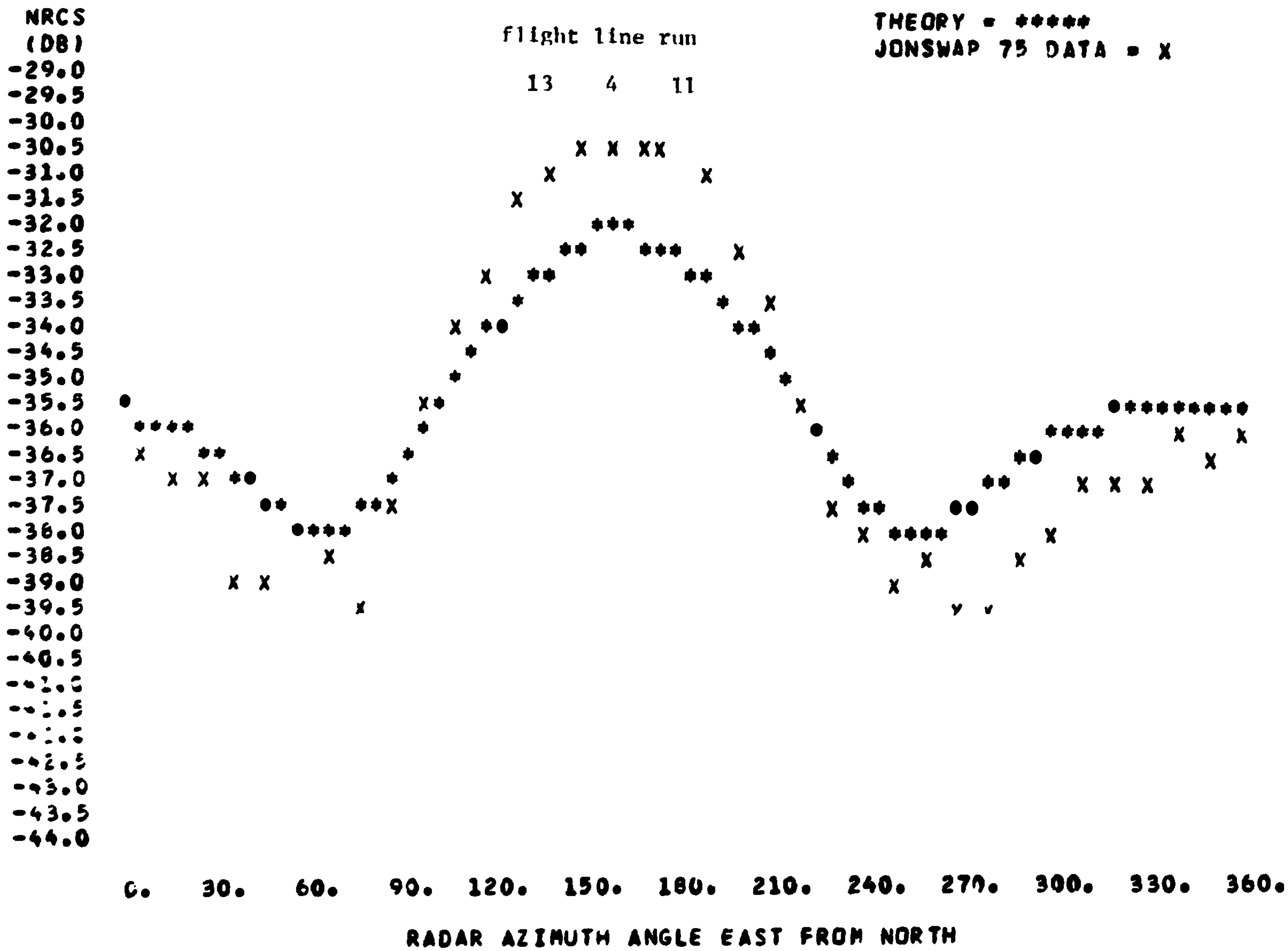
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 14.2 CM/SEC
WIND OUT OF 162. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG



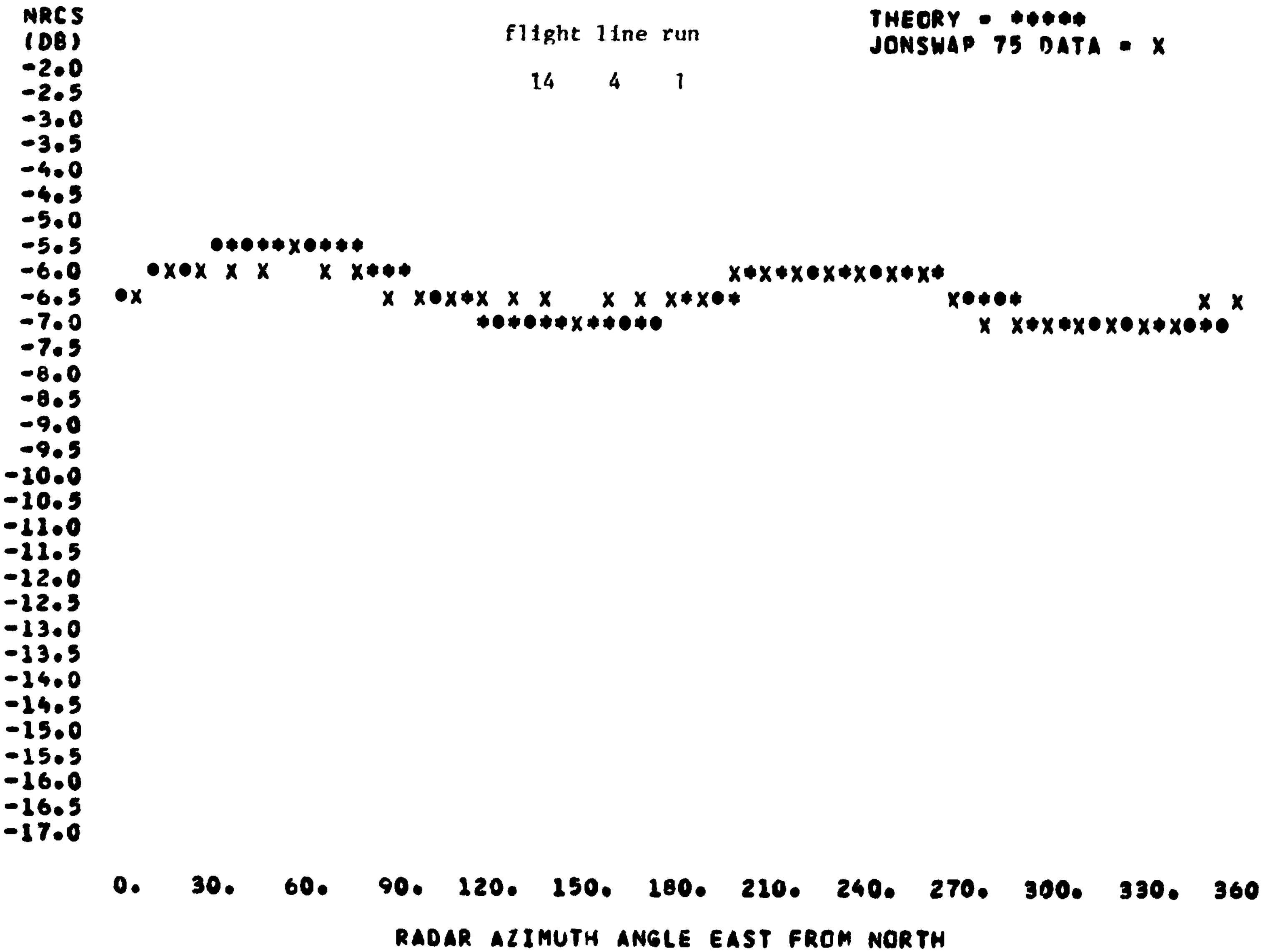
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 16.5 CM/SEC
WIND OUT OF 157. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 50. DEG



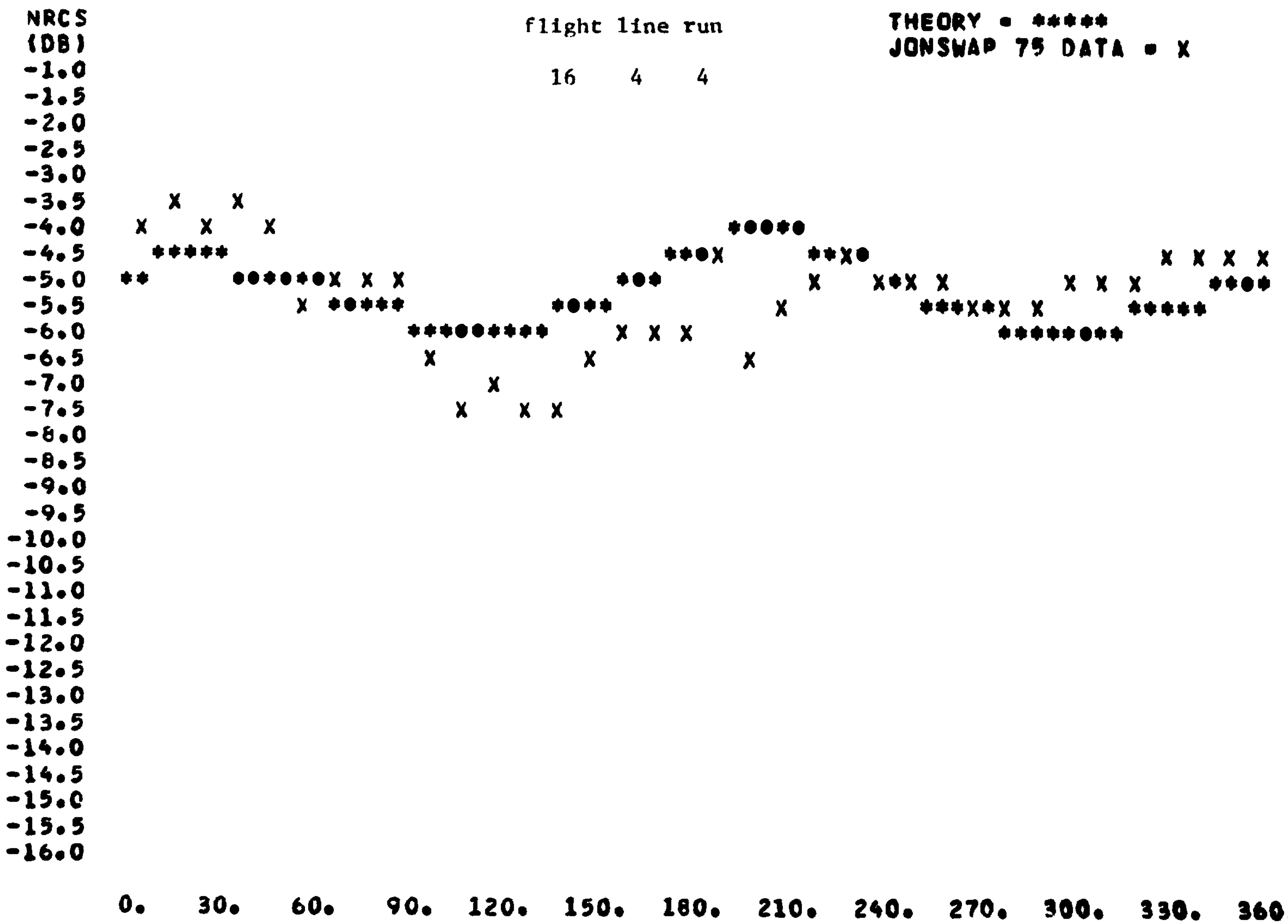
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 18.1 CM/SEC
WIND OUT OF 51. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG



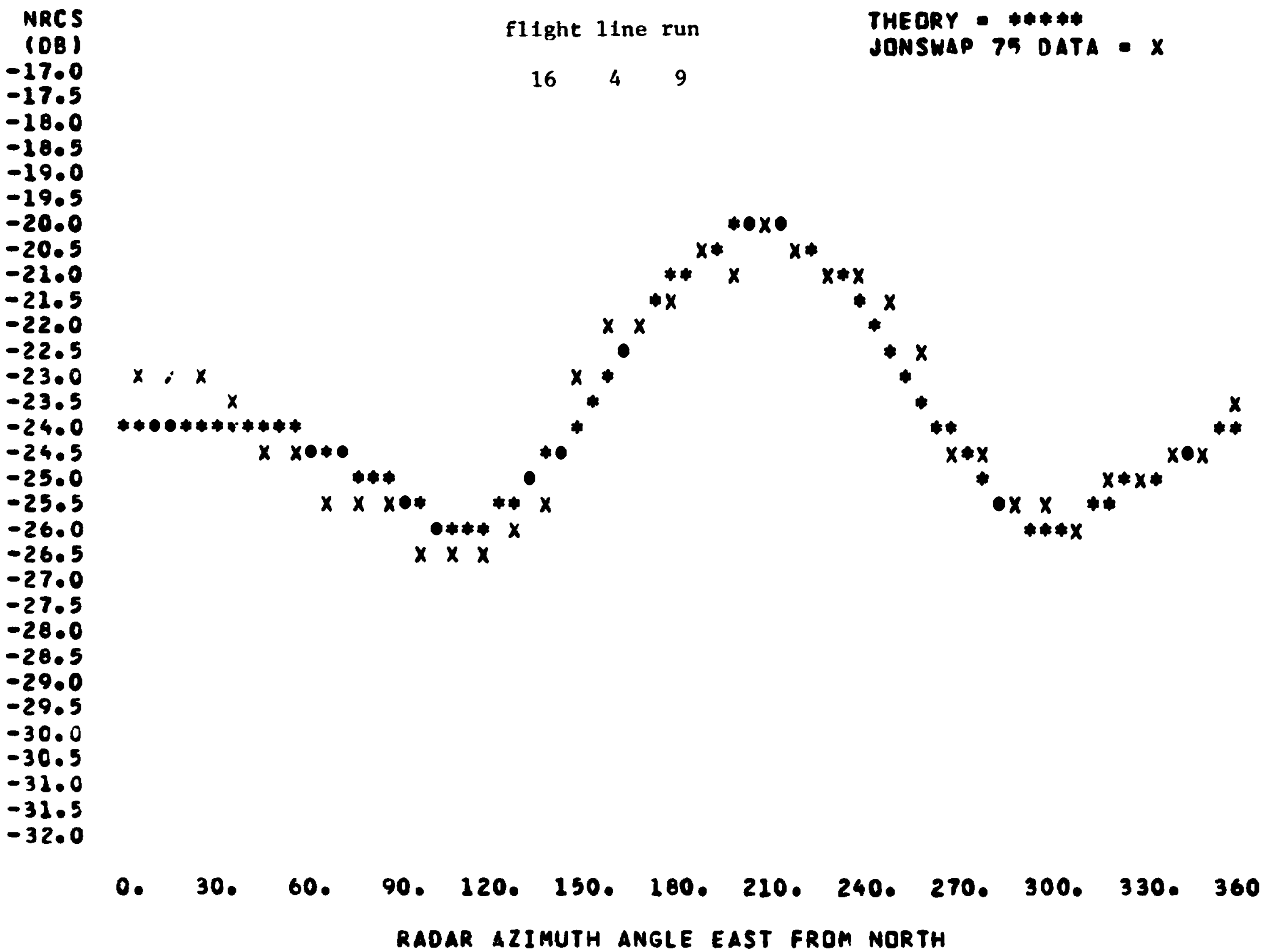
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 21.8 CM/SEC
WIND OUT OF 201. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG



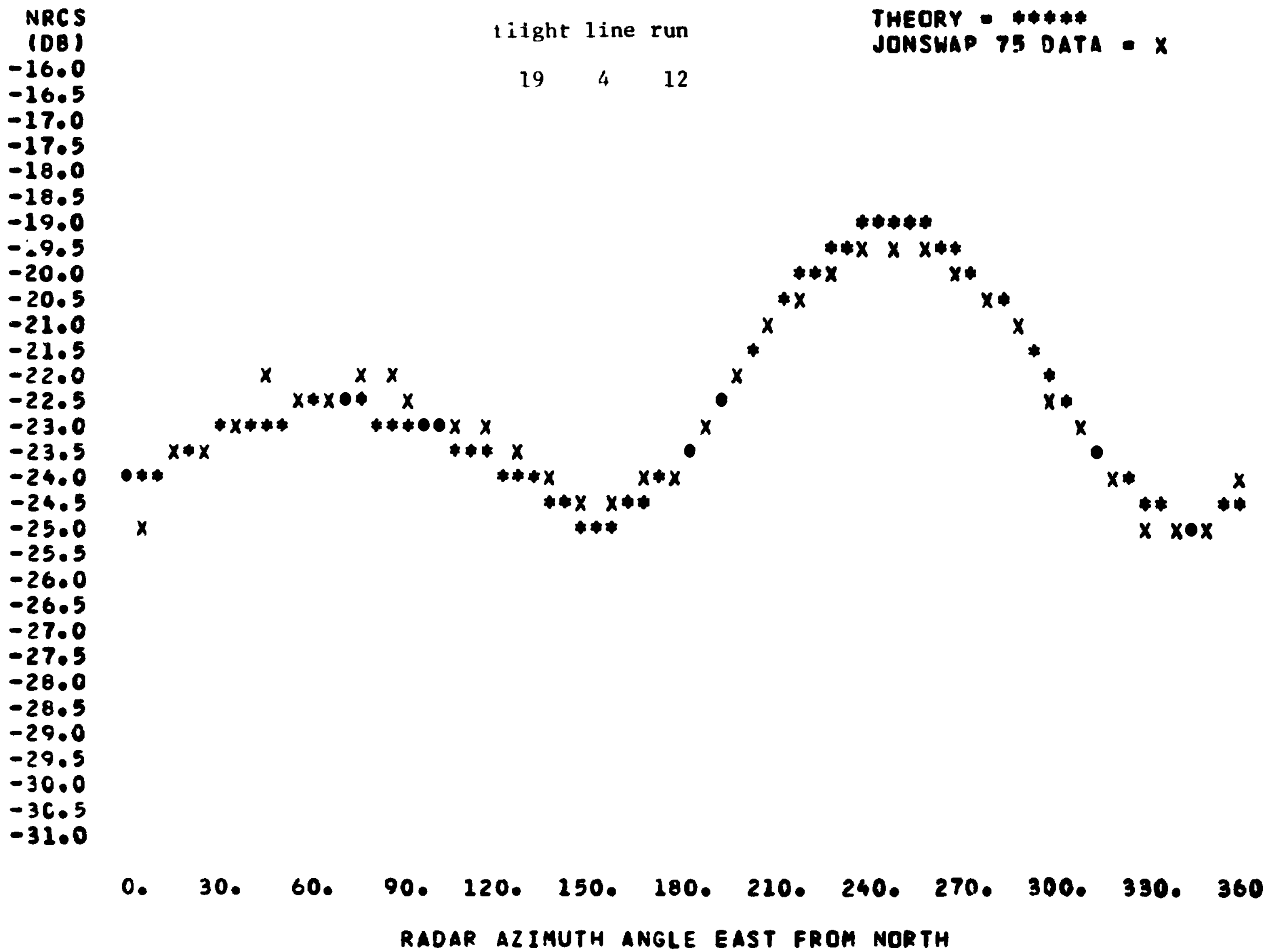
RADAR AZIMUTH ANGLE EAST FROM NORTH

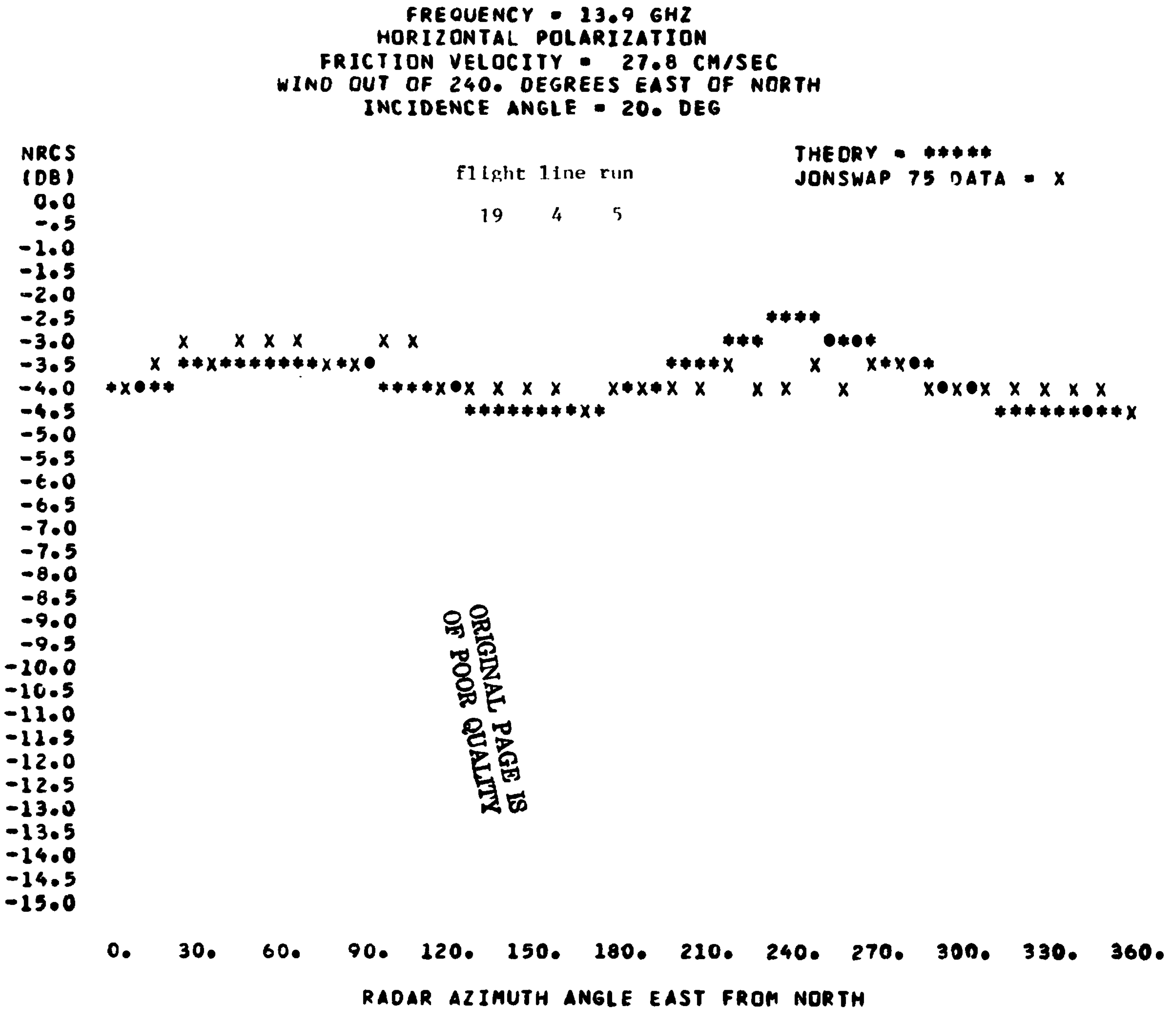
FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 25.2 CM/SEC
WIND OUT OF 203. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG



NRCS VERSUS AZIMUTH ANGLE

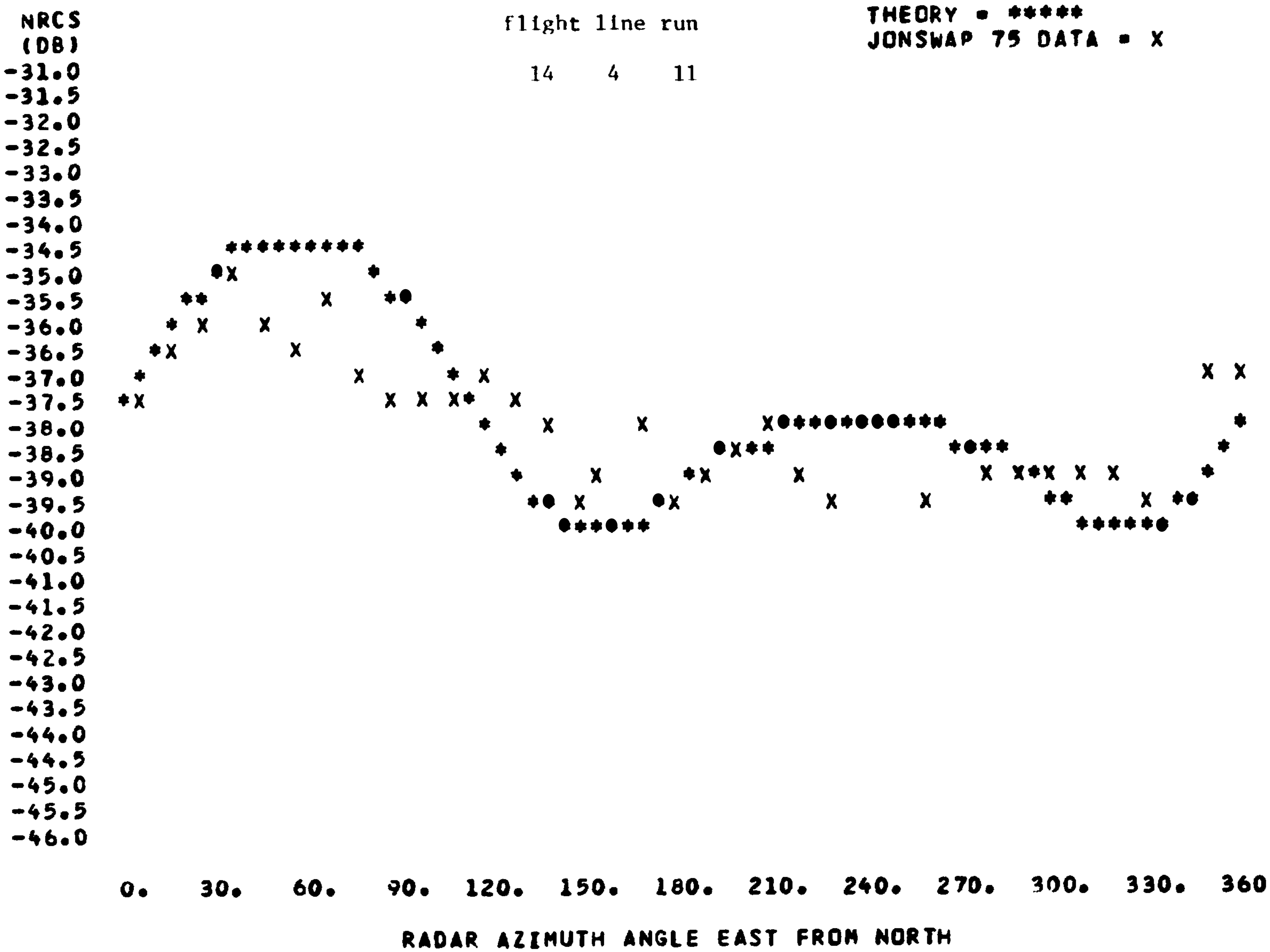
FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 27.4 CM/SEC
WIND OUT OF 245. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG

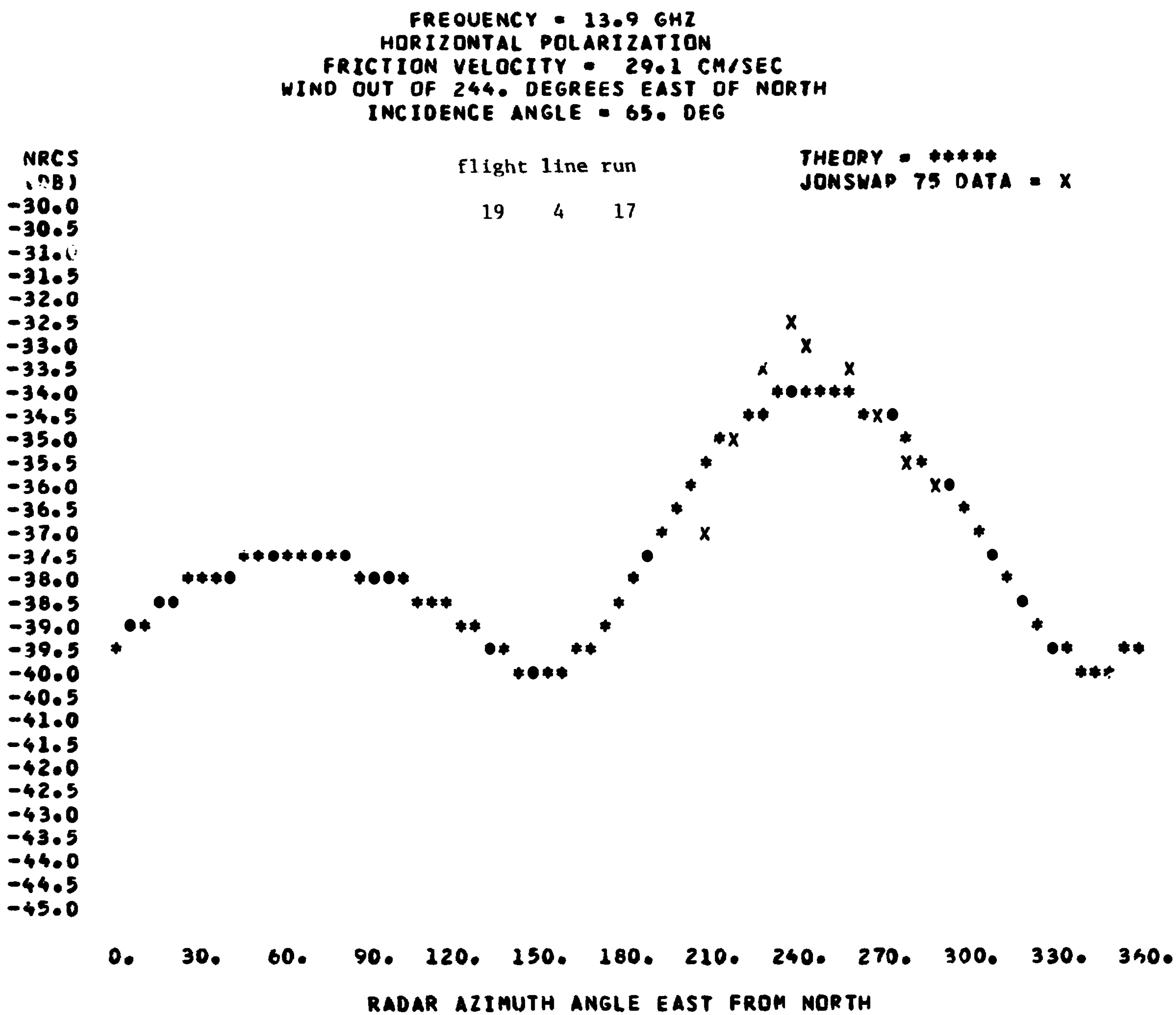



FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 27.8 CM/SEC
WIND OUT OF 240. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG
NRCS (DB)
flight line run
19 4 5
THEORY = *****
JONSWAP 75 DATA = X
0.0
-.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
-11.0
-11.5
-12.0
-12.5
-13.0
-13.5
-14.0
-14.5
-15.0
0. 30. 60. 90. 120. 150. 180. 210. 240. 270. 300. 330. 360.
RADAR AZIMUTH ANGLE EAST FROM NORTH

NRCS VERSUS AZIMUTH ANGLE

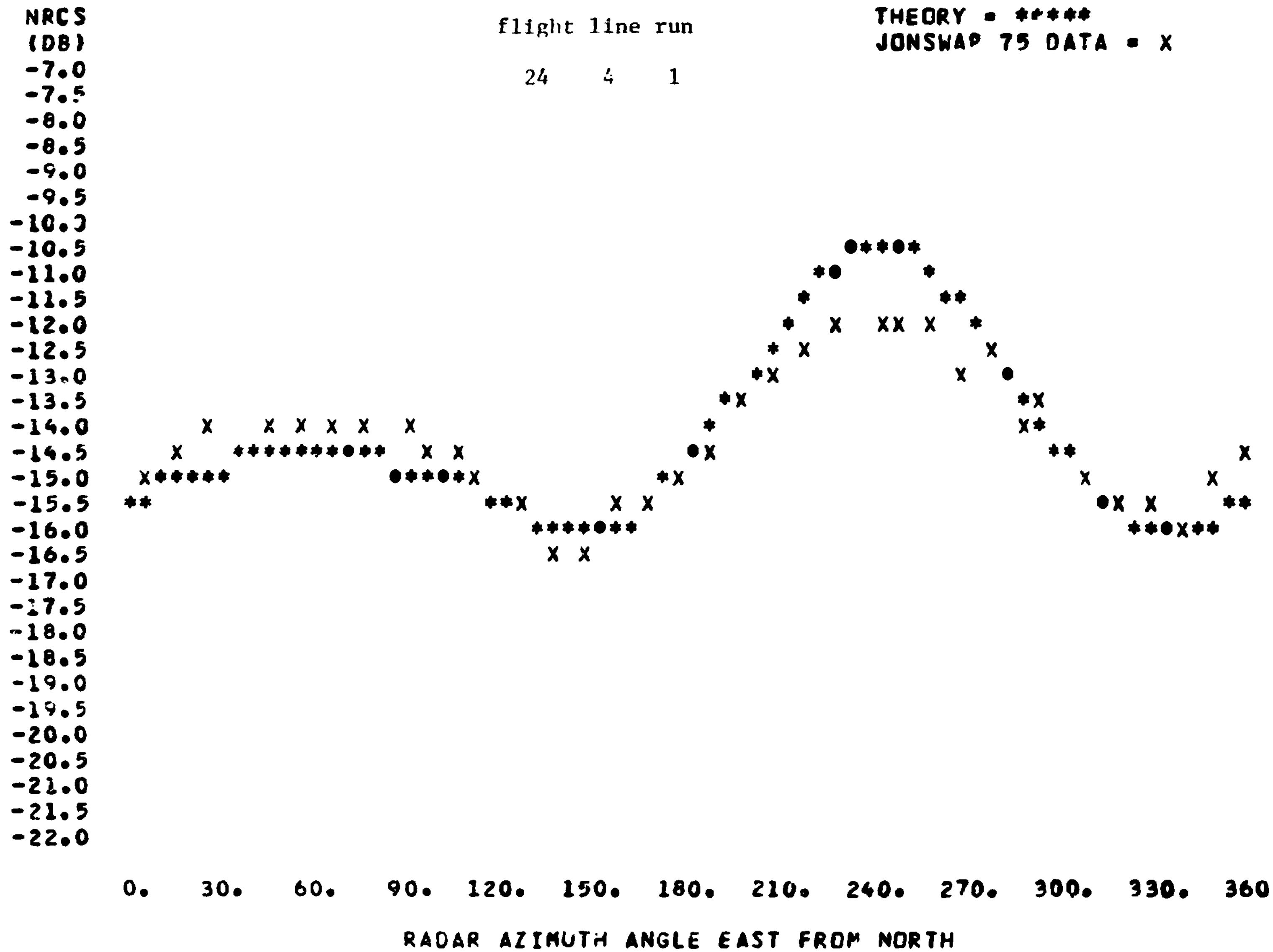
FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 28.4 CM/SEC
WIND OUT OF 55. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG



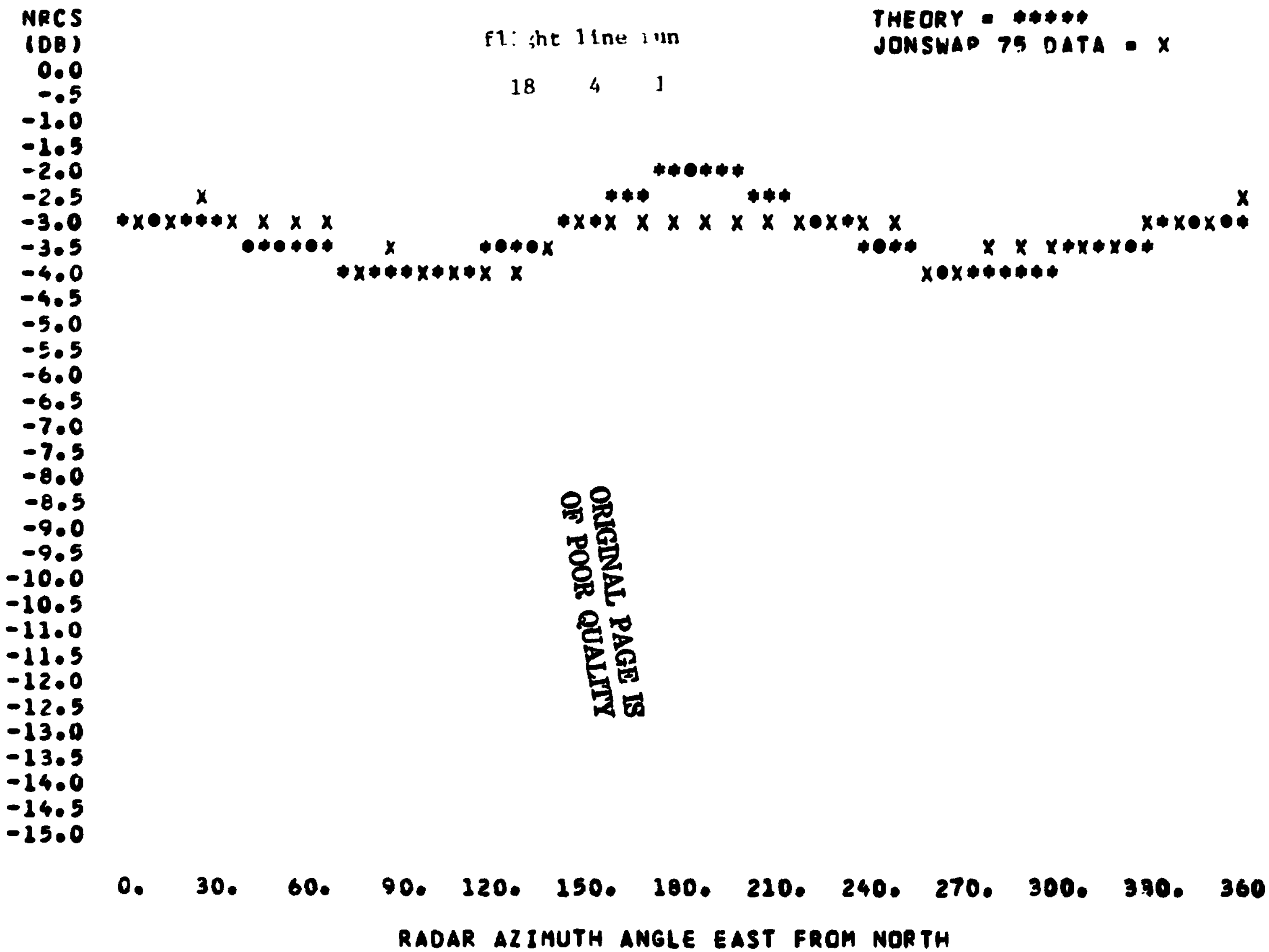

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 29.1 CM/SEC
WIND OUT OF 244. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG
NRCS (DB)
flight line run
19 4 17
THEORY = *****
JONSWAP 75 DATA = X
-30.0
-30.5
-31.0
-31.5
-32.0
-32.5
-33.0
-33.5
-34.0
-34.5
-35.0
-35.5
-36.0
-36.5
-37.0
-37.5
-38.0
-38.5
-39.0
-39.5
-40.0
-40.5
-41.0
-41.5
-42.0
-42.5
-43.0
-43.5
-44.0
-44.5
-45.0
0. 30. 60. 90. 120. 150. 180. 210. 240. 270. 300. 330. 360.
RADAR AZIMUTH ANGLE EAST FROM NORTH

NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 30.7 CM/SEC
WIND OUT OF 239. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 30. DEG

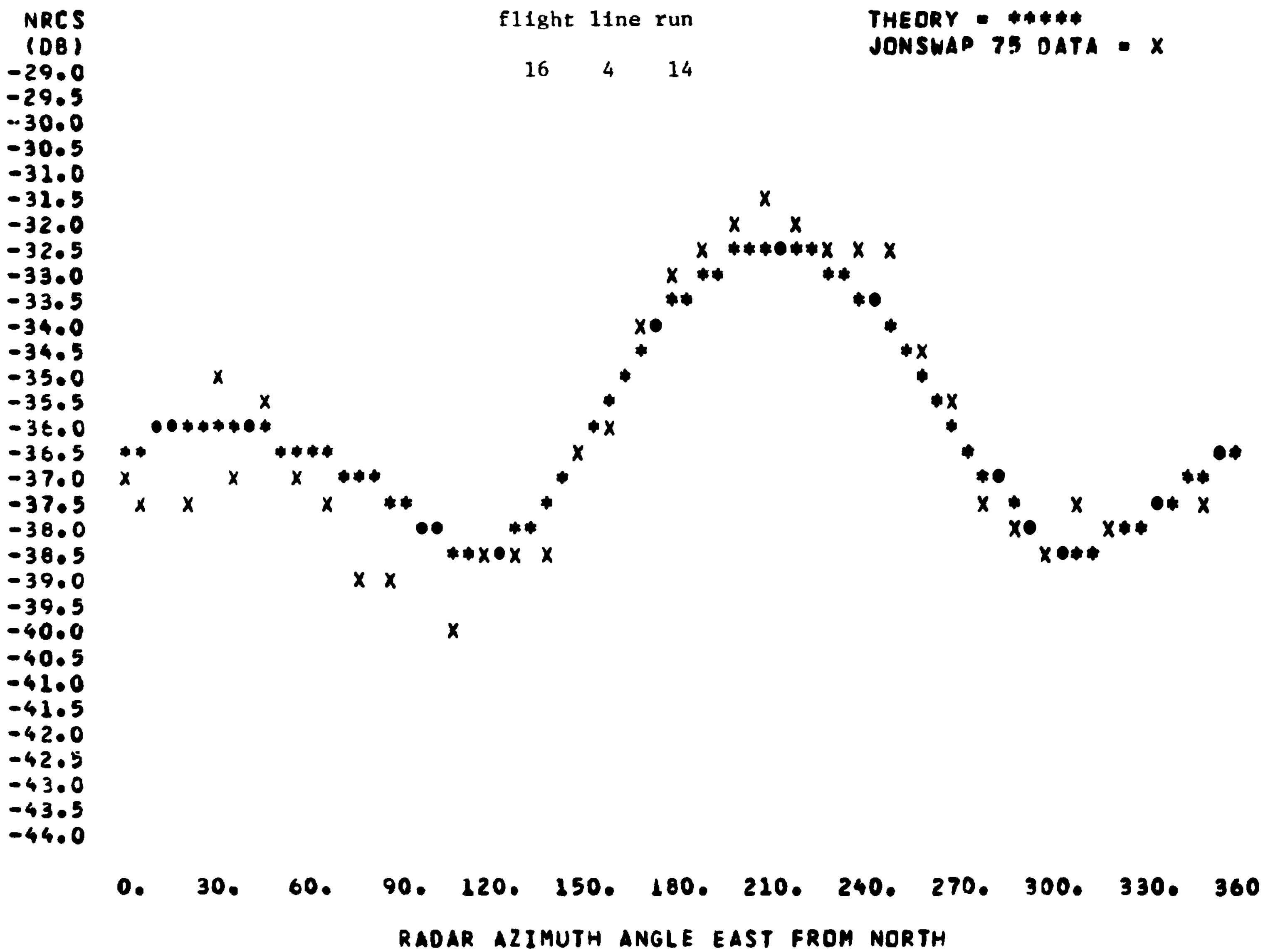


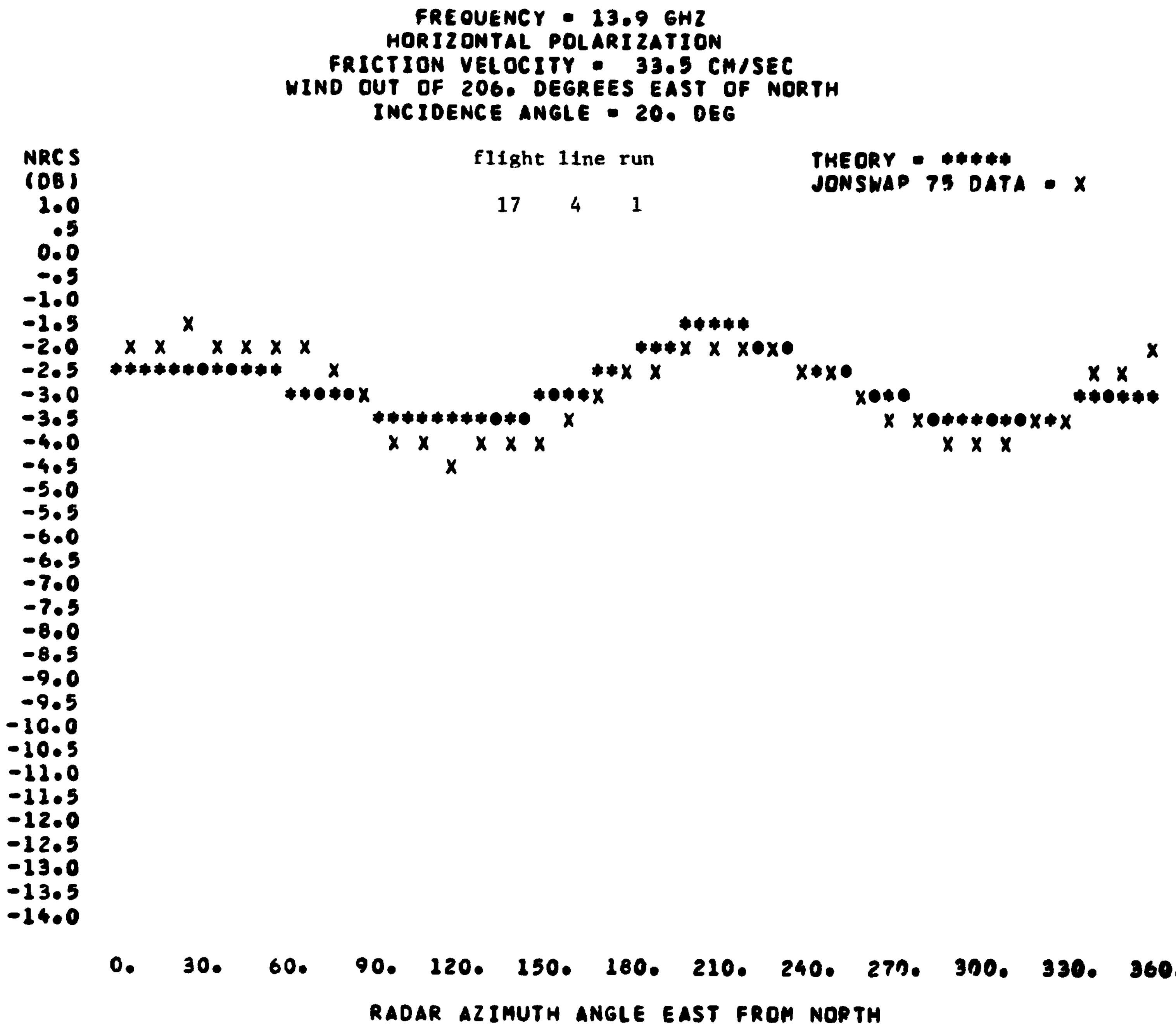
FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 30.9 CM/SEC
WIND OUT OF 183. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG



NRCS VERSUS AZIMUTH ANGLE

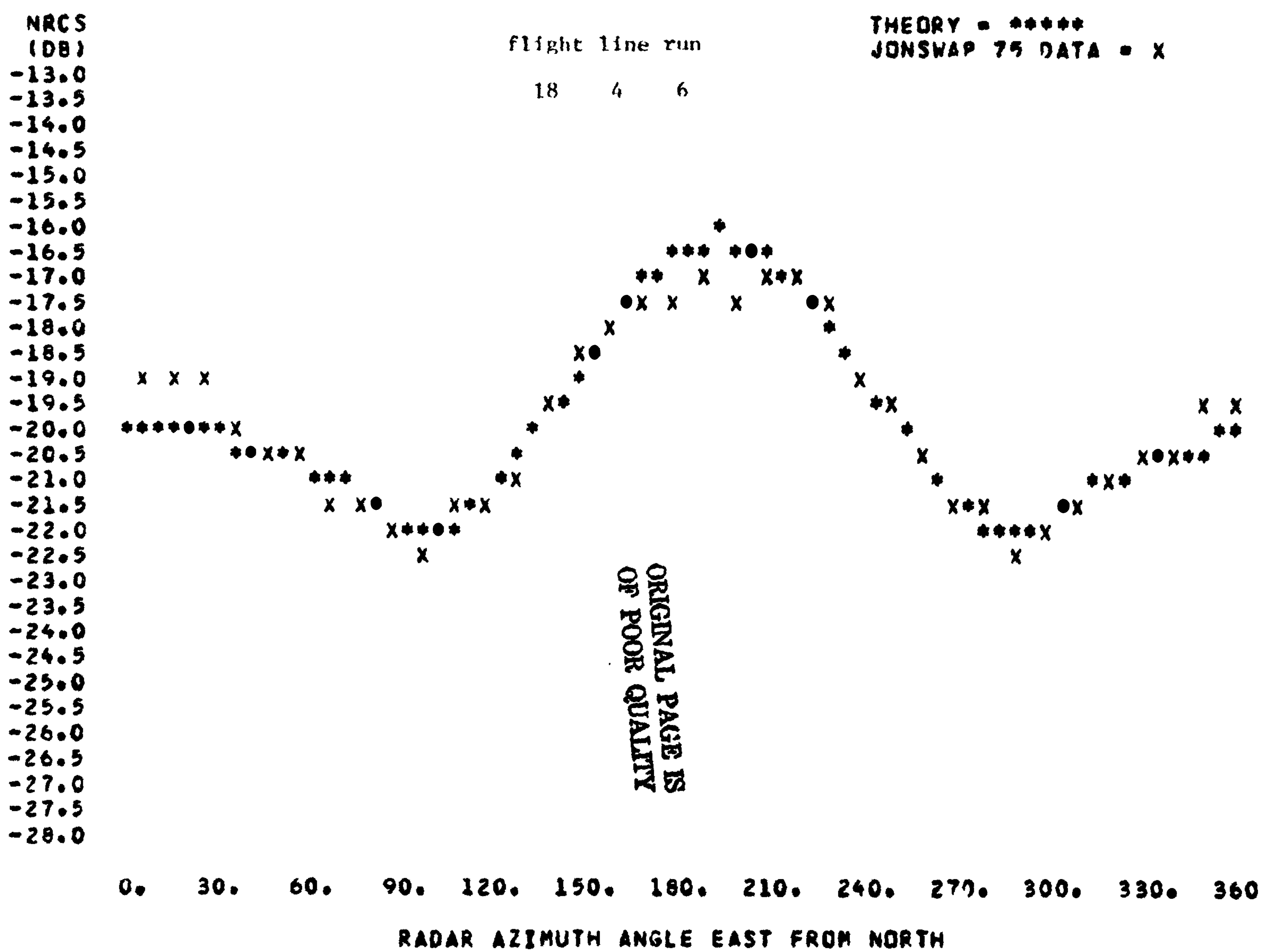
FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 32.6 CM/SEC
WIND OUT OF 208. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG



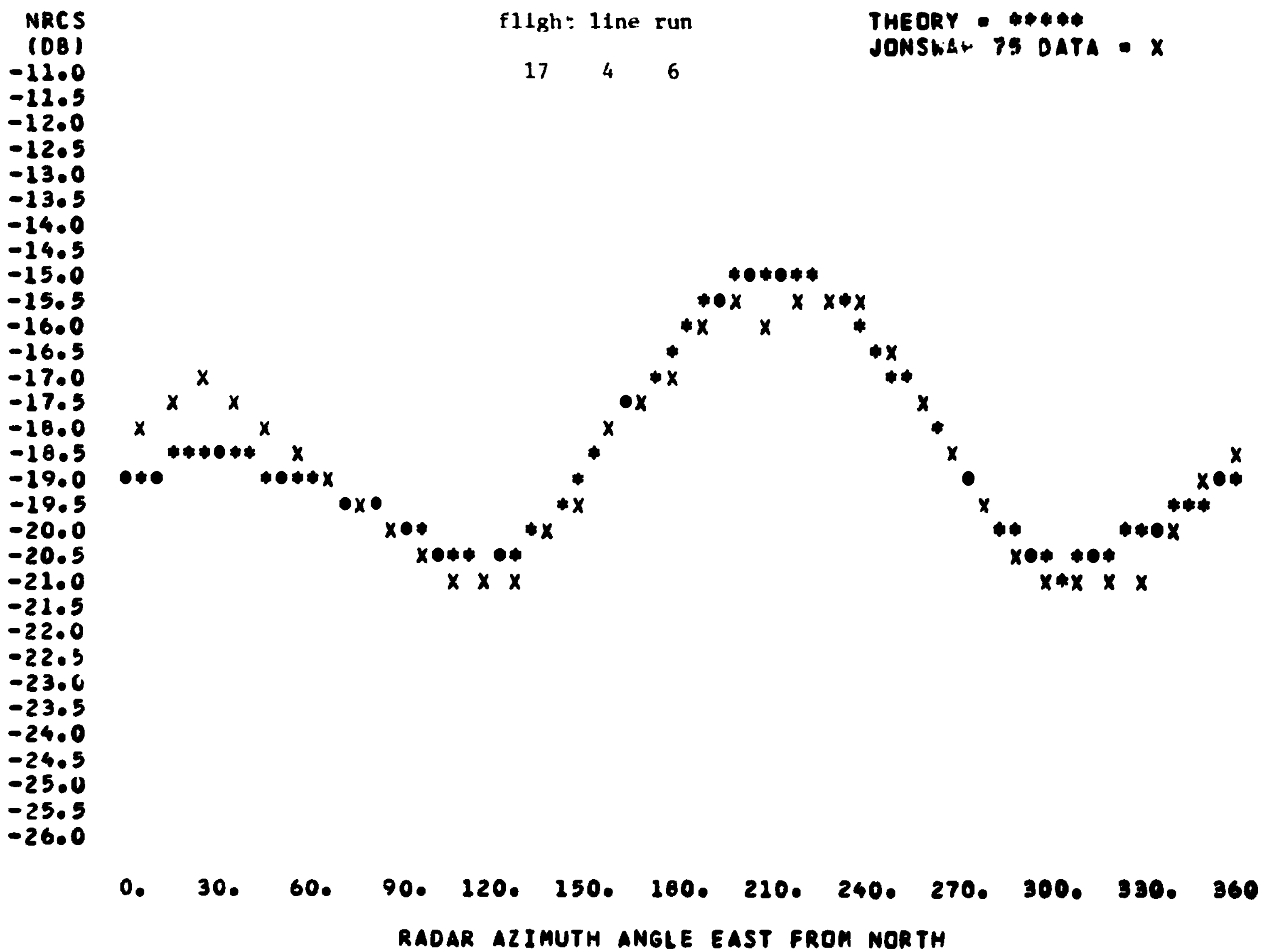

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 33.5 CM/SEC
WIND OUT OF 206. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG
NRCS (DB)
flight line run
17 4 1
THEORY = *****
JONSWAP 75 DATA = X
1.0 .5 0.0 -.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0 -10.5 -11.0 -11.5 -12.0 -12.5 -13.0 -13.5 -14.0
0. 30. 60. 90. 120. 150. 180. 210. 240. 270. 300. 330. 360.
RADAR AZIMUTH ANGLE EAST FROM NORTH

NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 33.8 CM/SEC
WIND OUT OF 190. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG

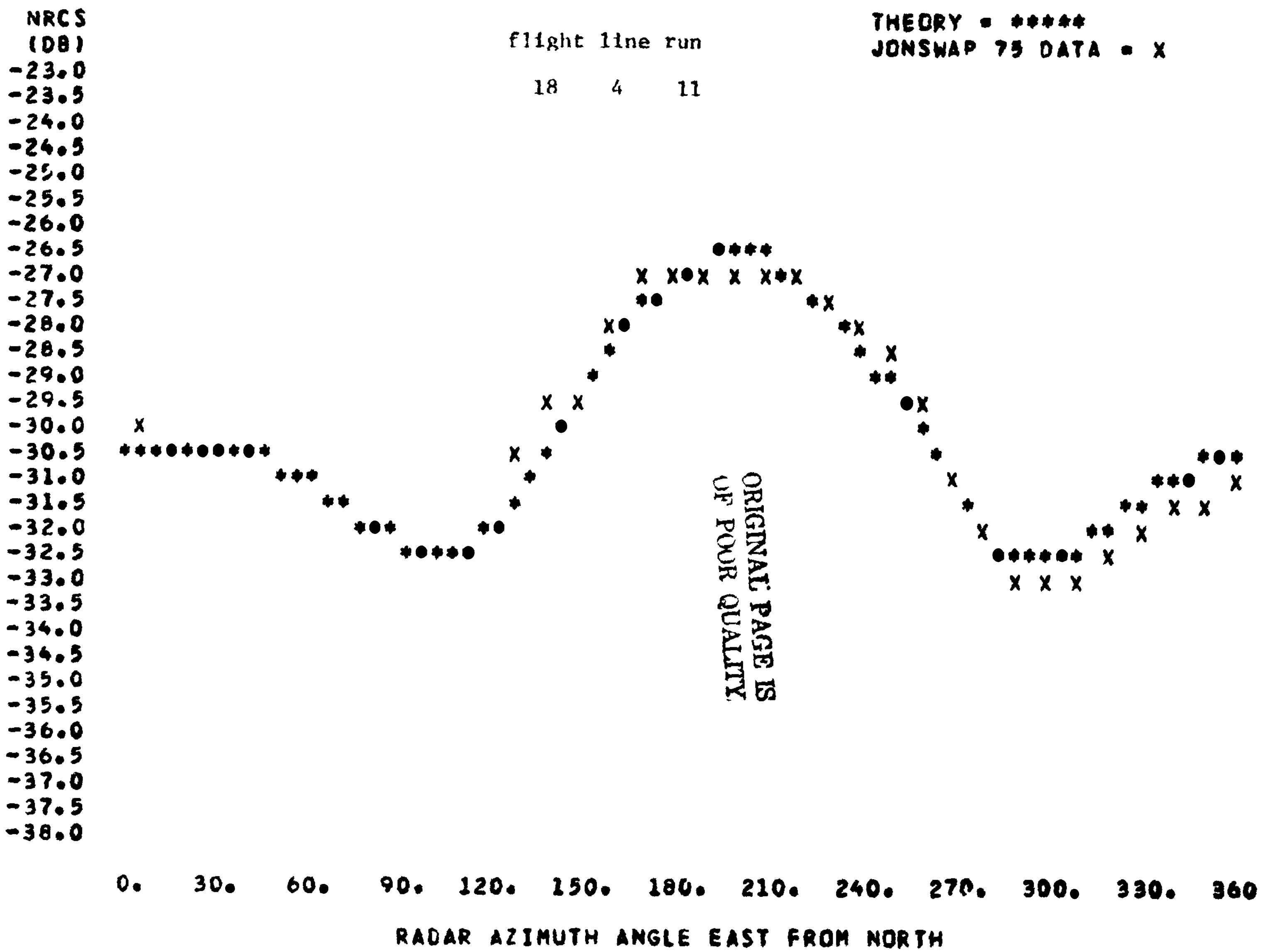


FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 37.5 CM/SEC
WIND OUT OF 208. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG

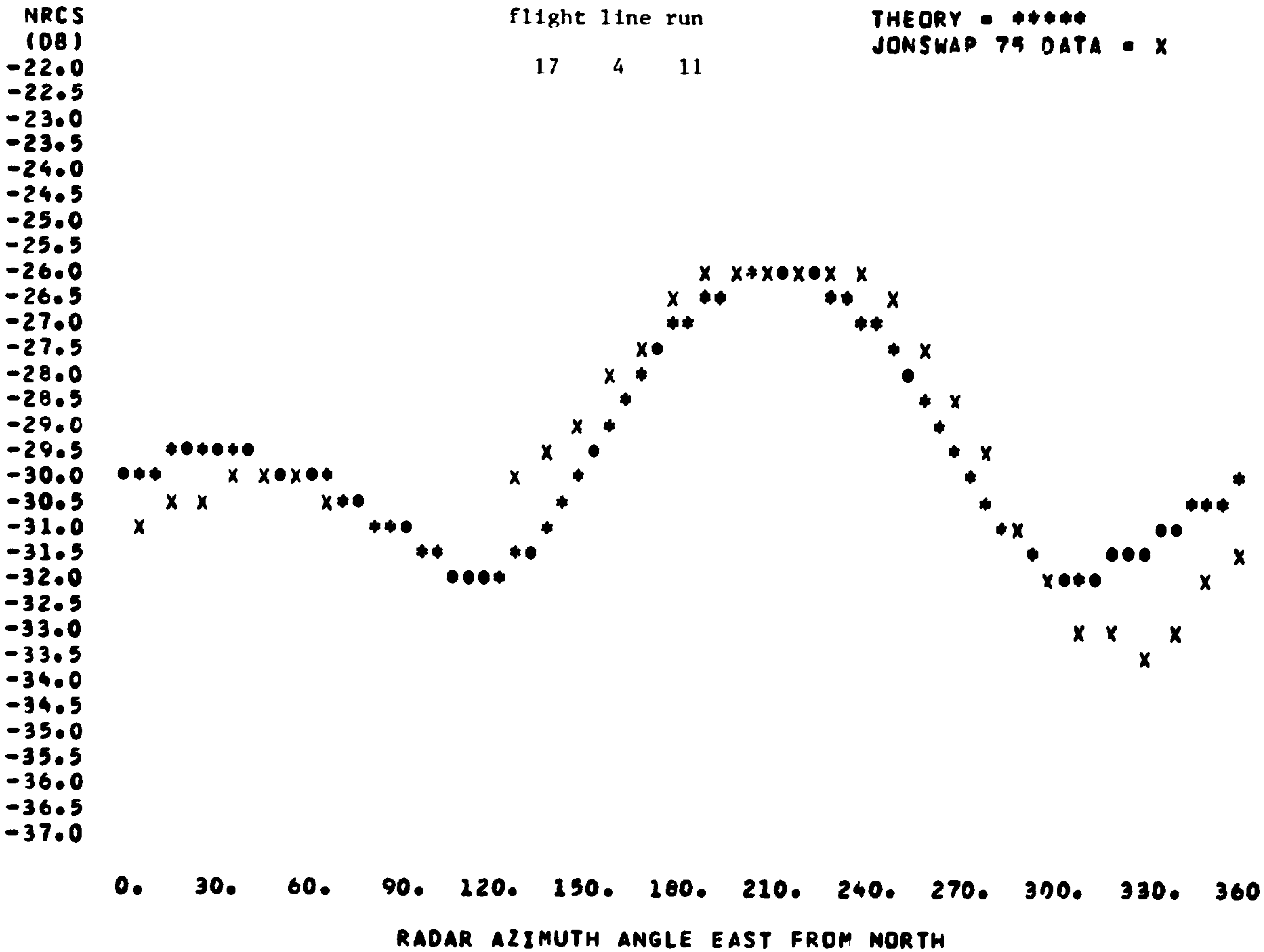


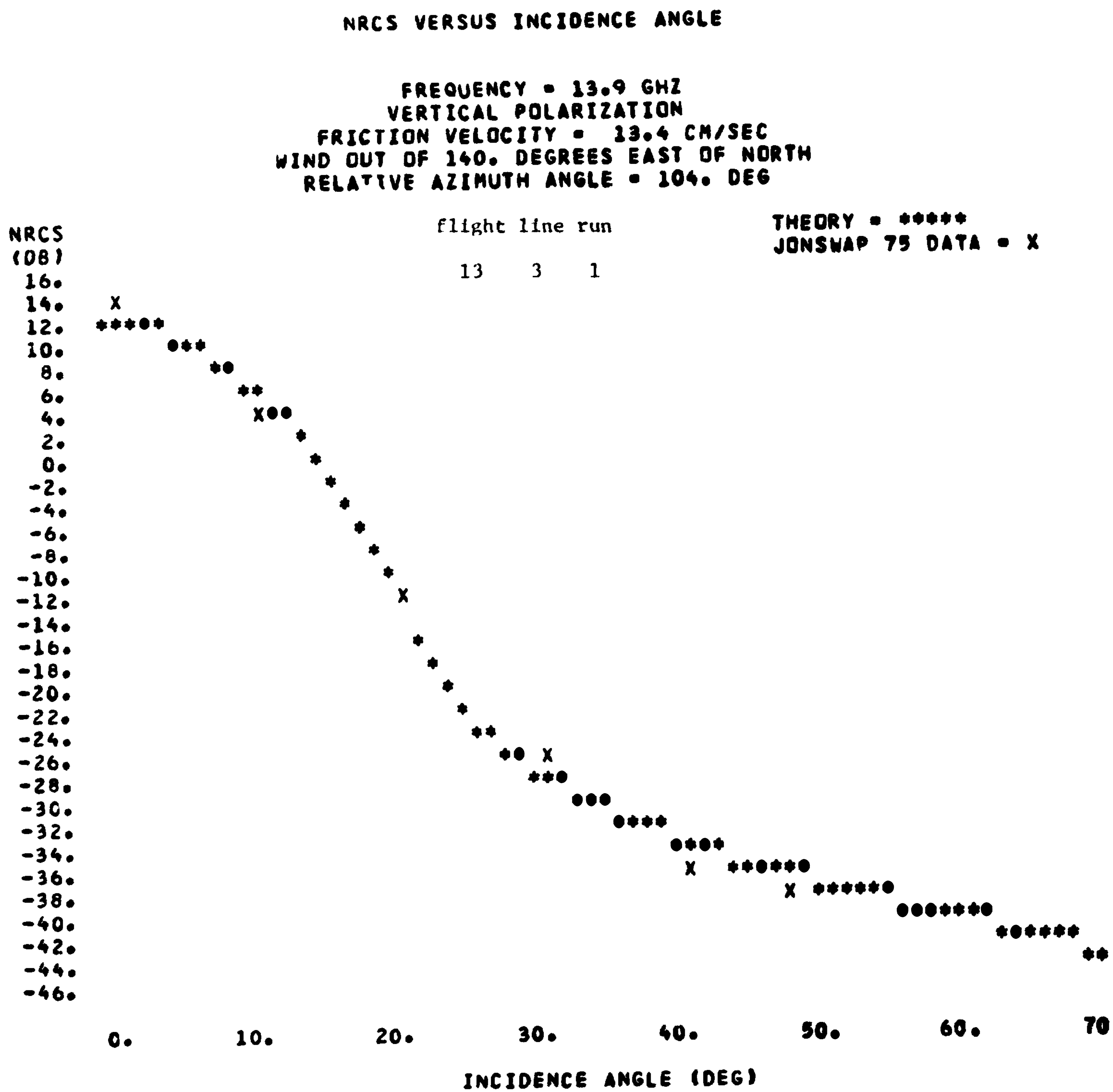
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 50.5 CM/SEC
WIND OUT OF 196. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG

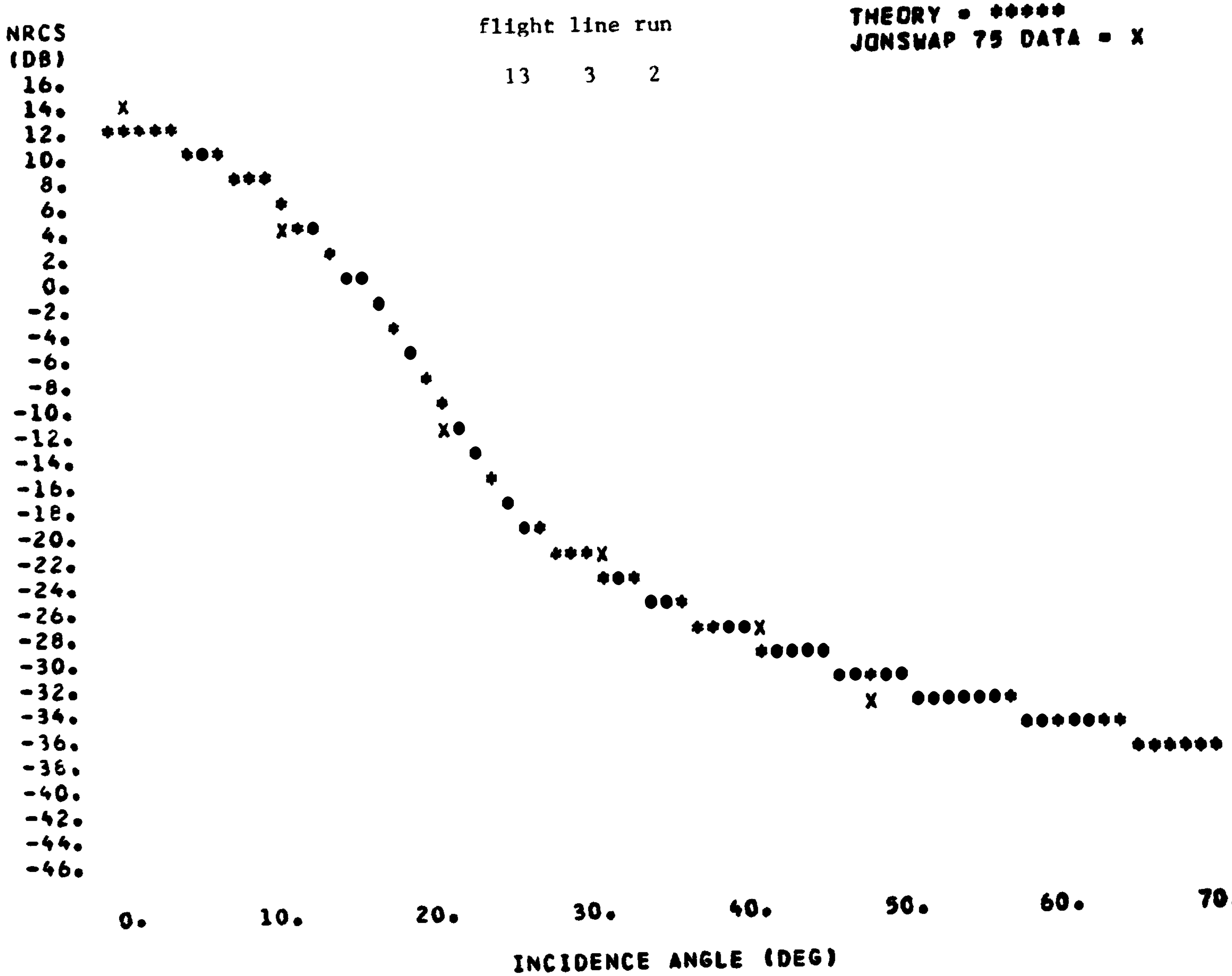


FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 53.2 CM/SEC
WIND OUT OF 208. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG



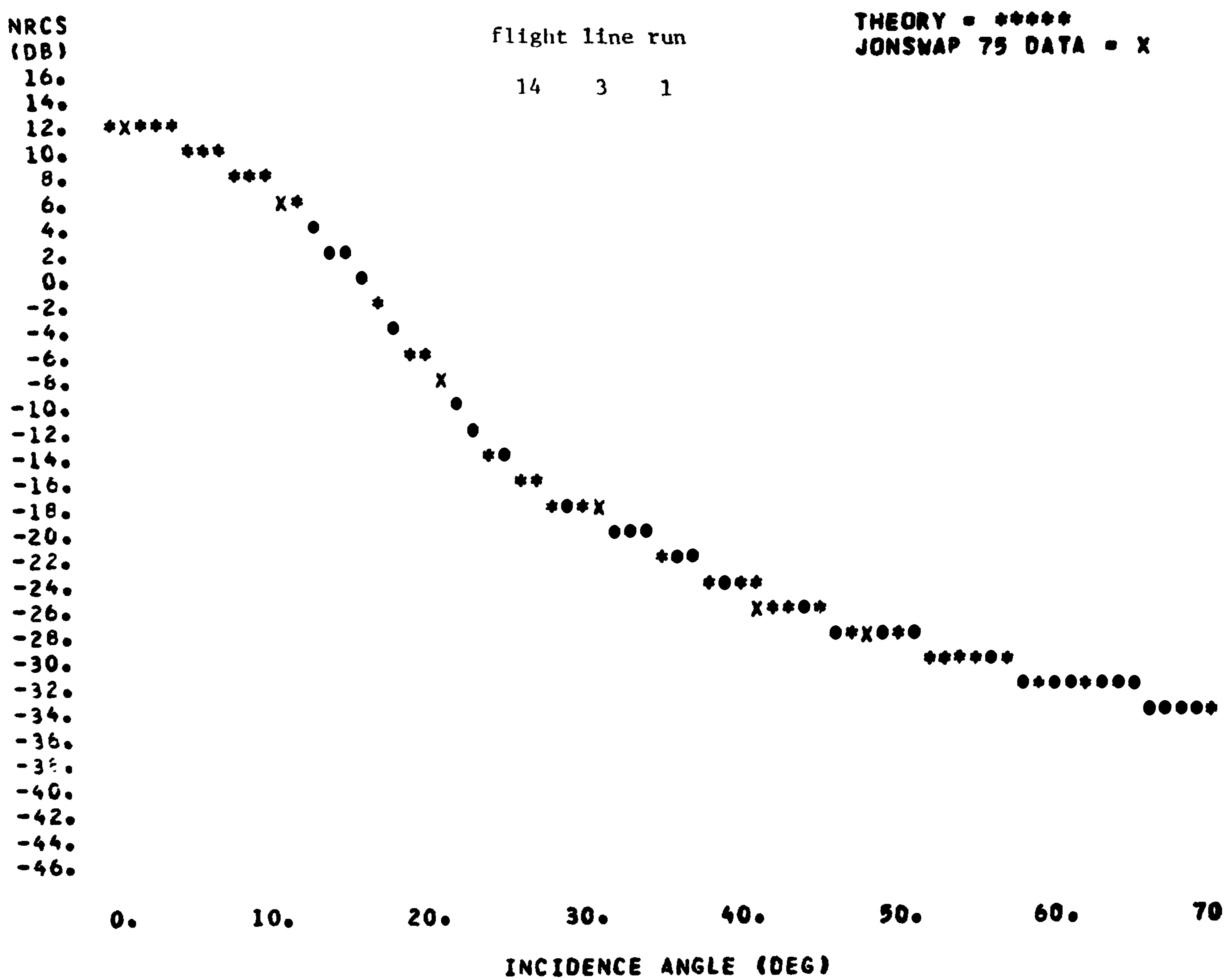

NRCS VERSUS INCIDENCE ANGLE
FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 13.4 CM/SEC
WIND OUT OF 140. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 104. DEG
flight line run
13 3 1
THEORY = *****
JONSWAP 75 DATA = X
NRCS (DB)
16.
14.
12.
10.
8.
6.
4.
2.
0.
-2.
-4.
-6.
-8.
-10.
-12.
-14.
-16.
-18.
-20.
-22.
-24.
-26.
-28.
-30.
-32.
-34.
-36.
-38.
-40.
-42.
-44.
-46.
0.
10.
20.
30.
40.
50.
60.
70.
INCIDENCE ANGLE (DEG)

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 15.9 CM/SEC
WIND OUT OF 157. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 59. DEG

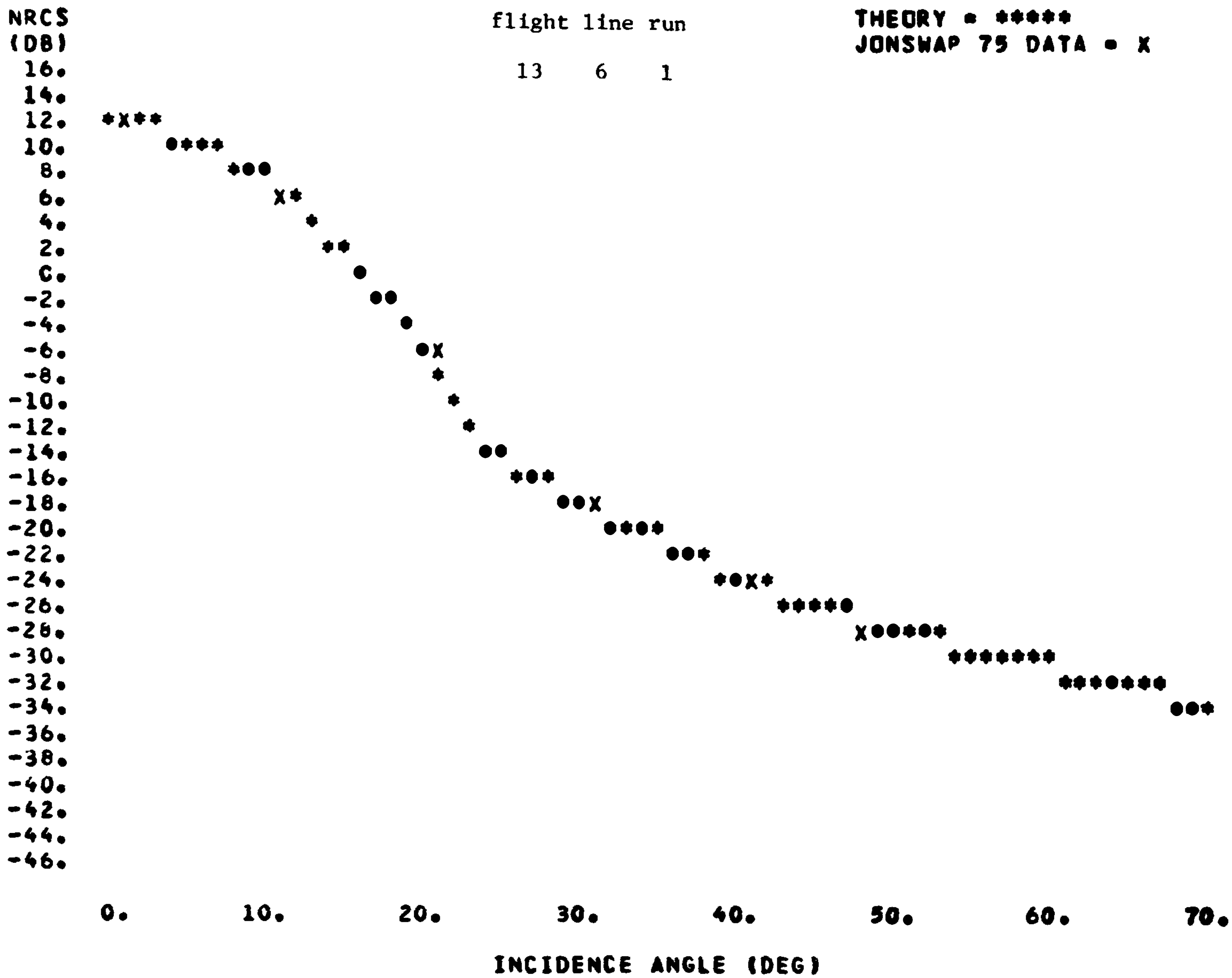


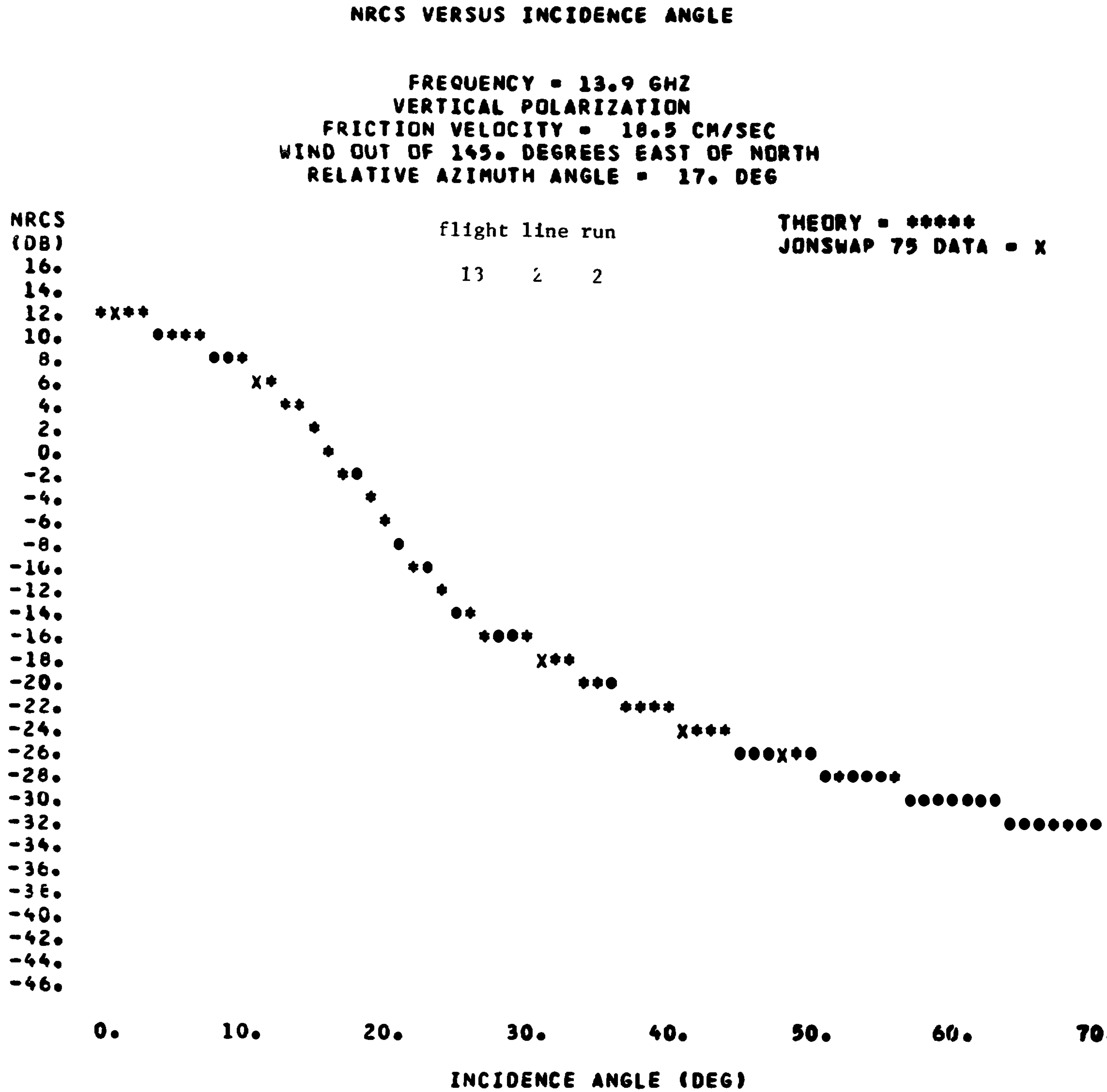
NRCS VERSUS INCIDENCE ANGLE

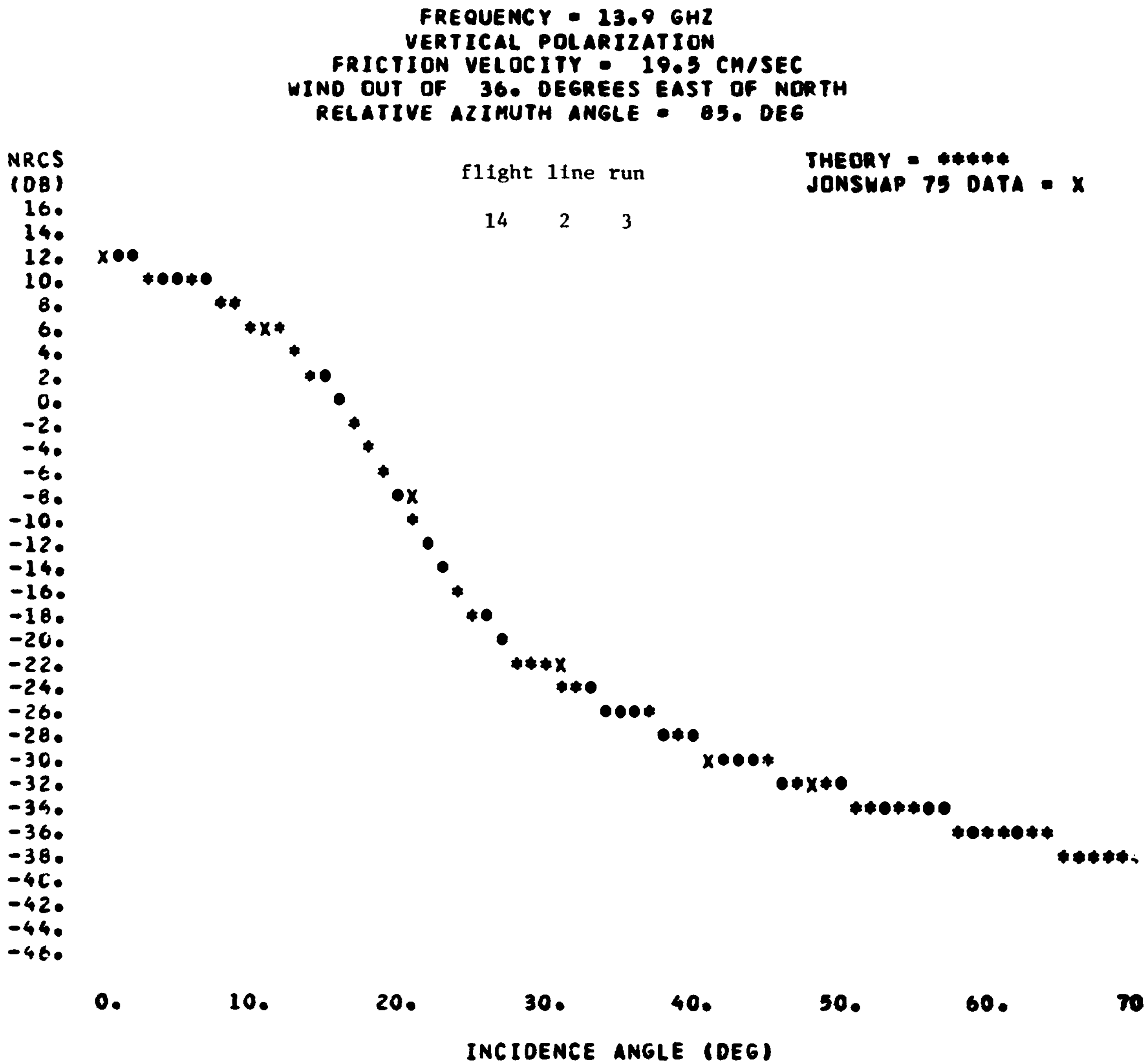
FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 16.3 CM/SEC
WIND OUT OF 51. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 10. DEG



FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 17.9 CM/SEC
WIND OUT OF 150. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 23. DEG

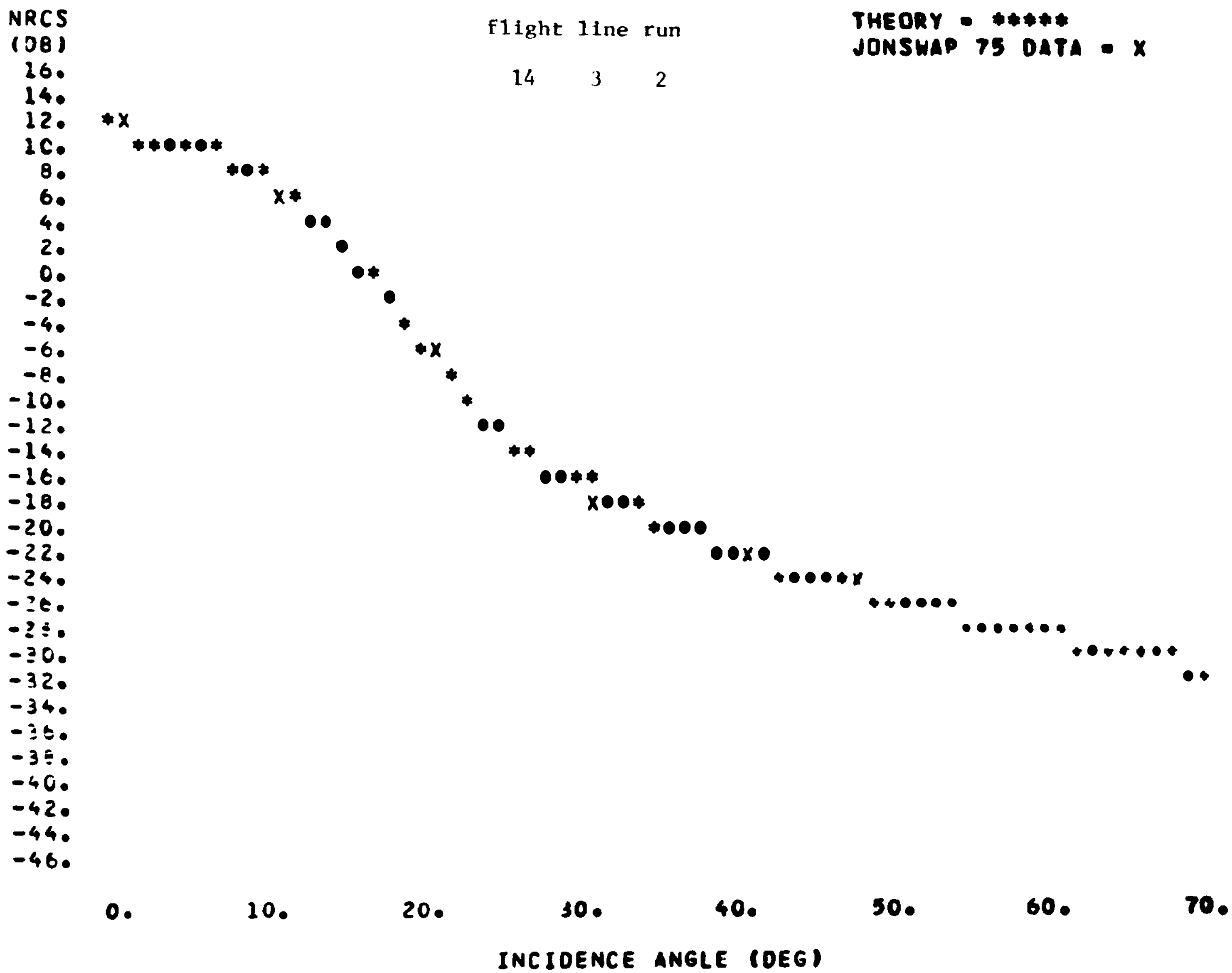



NRCS VERSUS INCIDENCE ANGLE
FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 18.5 CM/SEC
WIND OUT OF 145. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 17. DEG
NRCS (DB)
flight line run
13 2 2
THEORY = *****
JONSWAP 75 DATA = X
16.
14.
12.
10.
8.
6.
4.
2.
0.
-2.
-4.
-6.
-8.
-10.
-12.
-14.
-16.
-18.
-20.
-22.
-24.
-26.
-28.
-30.
-32.
-34.
-36.
-38.
-40.
-42.
-44.
-46.
0.
10.
20.
30.
40.
50.
60.
70.
INCIDENCE ANGLE (DEG)

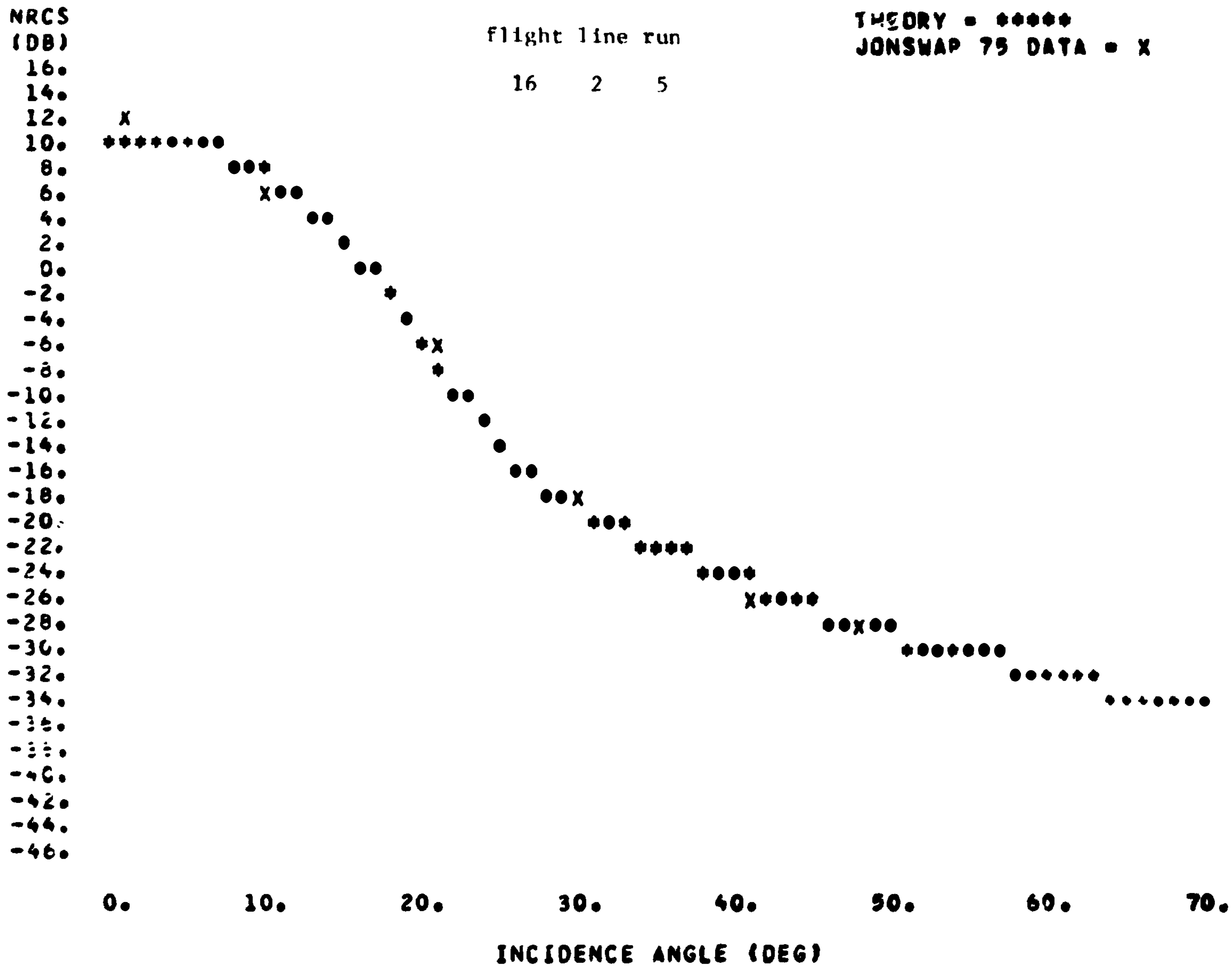

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 19.5 CM/SEC
WIND OUT OF 36. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 85. DEG
NRCS (DB)
flight line run
14 2 3
THEORY = *****
JONSWAP 75 DATA = X
16.
14.
12.
10.
8.
6.
4.
2.
0.
-2.
-4.
-6.
-8.
-10.
-12.
-14.
-16.
-18.
-20.
-22.
-24.
-26.
-28.
-30.
-32.
-34.
-36.
-38.
-40.
-42.
-44.
-46.
0.
10.
20.
30.
40.
50.
60.
70.
INCIDENCE ANGLE (DEG)

NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 21.4 CM/SEC
WIND OUT OF 49. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 172. DEG

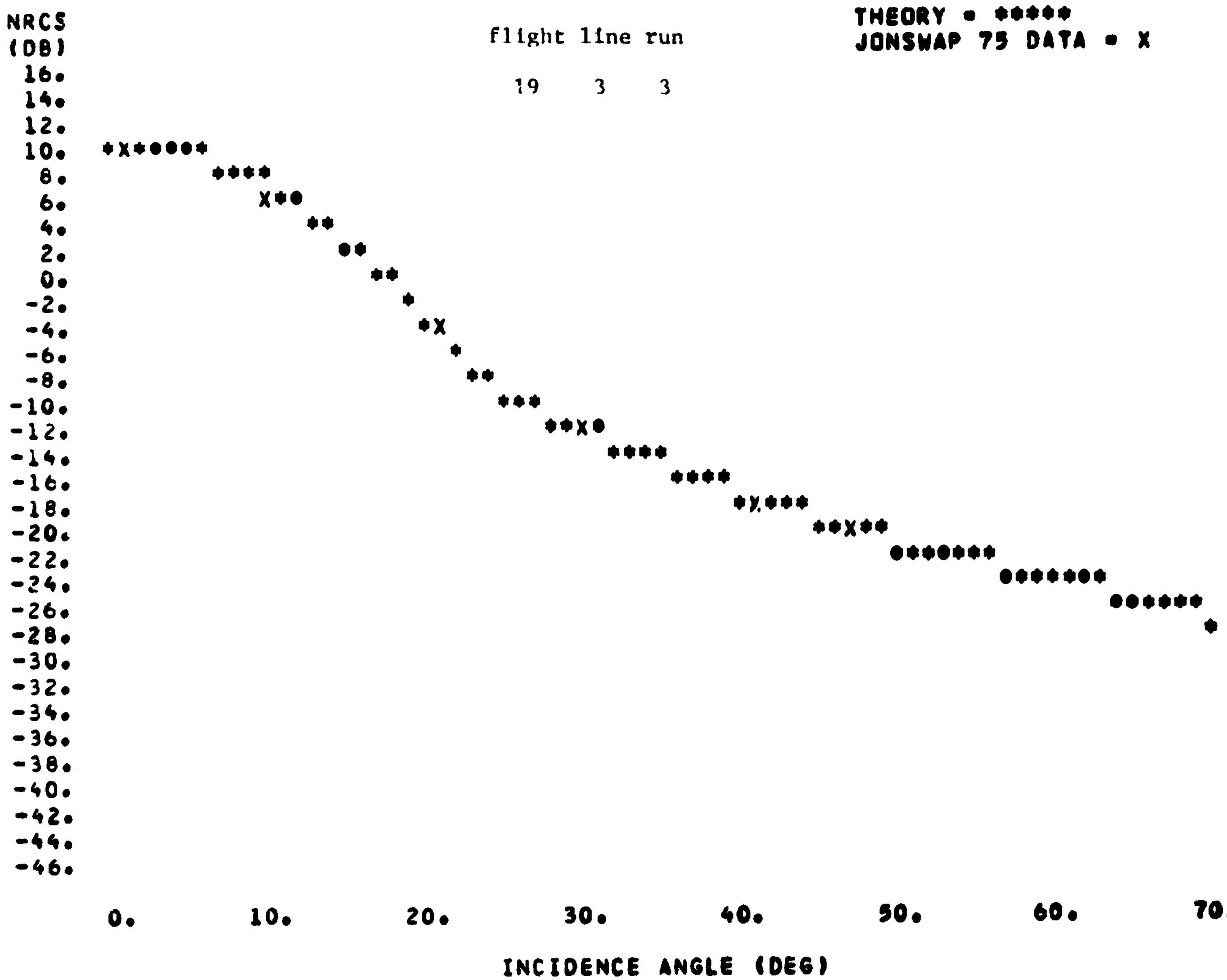


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 24.4 CM/SEC
WIND OUT OF 189. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 105. DEG



NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 29.9 CM/SEC
WIND OUT OF 229. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 165. DEG



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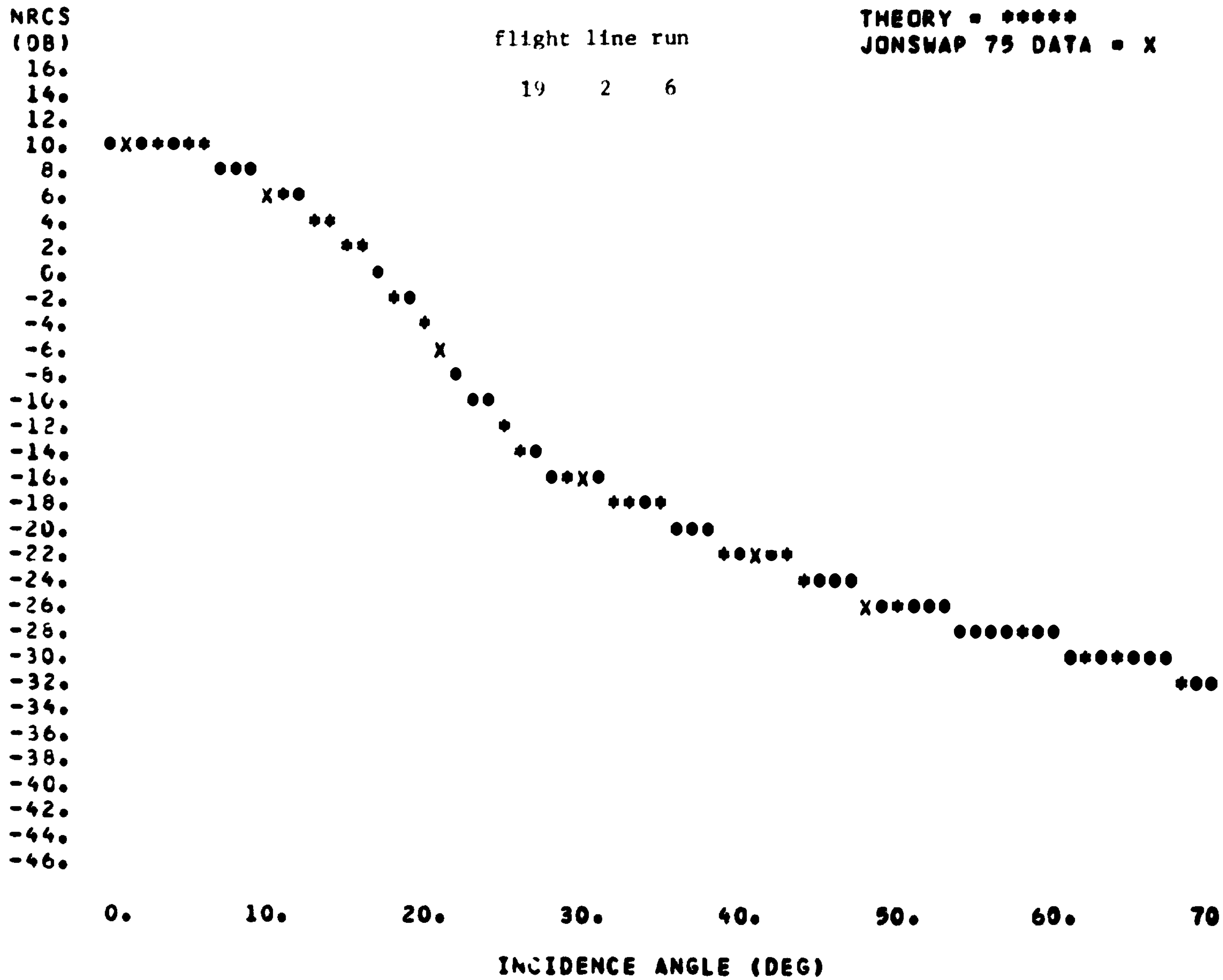
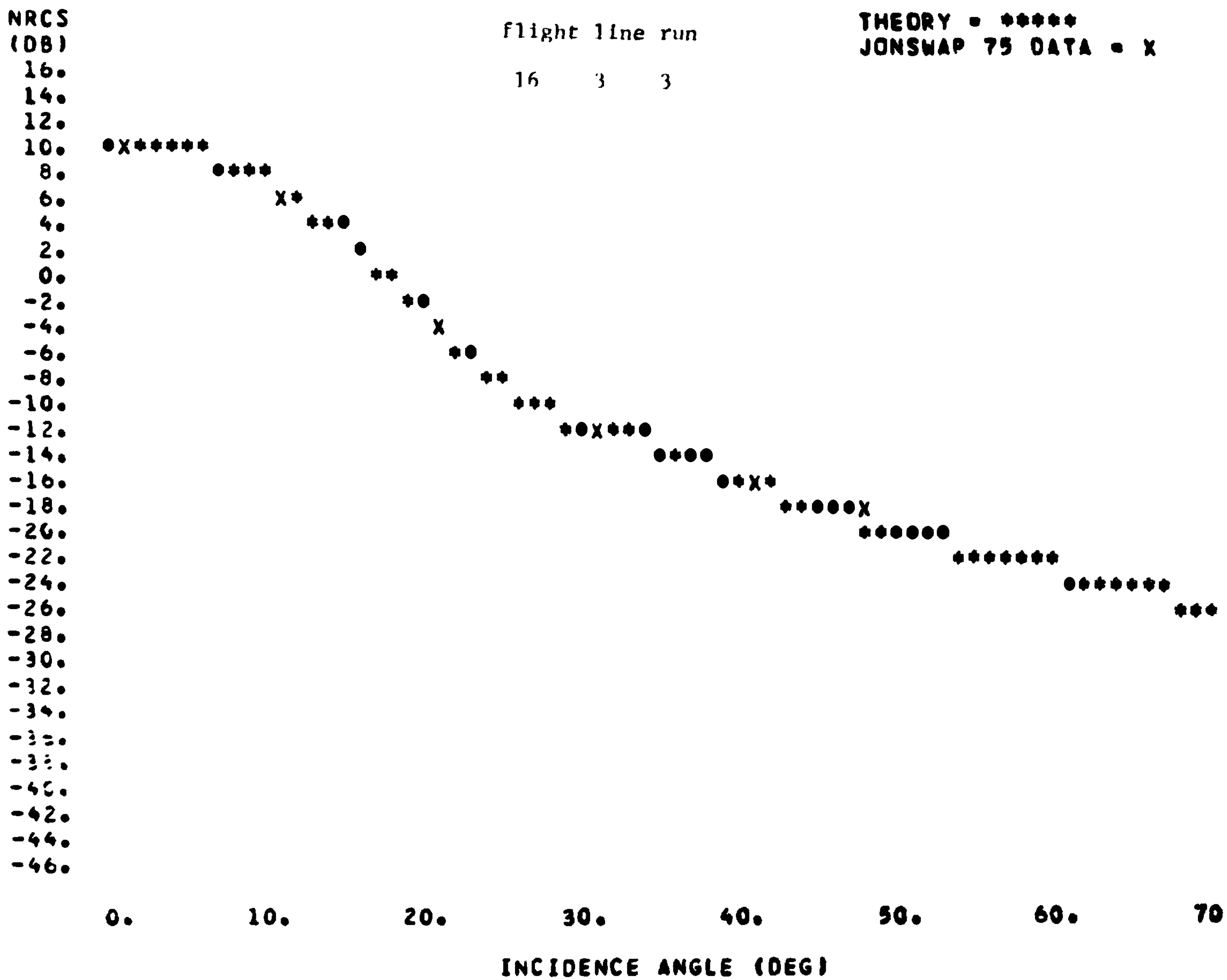
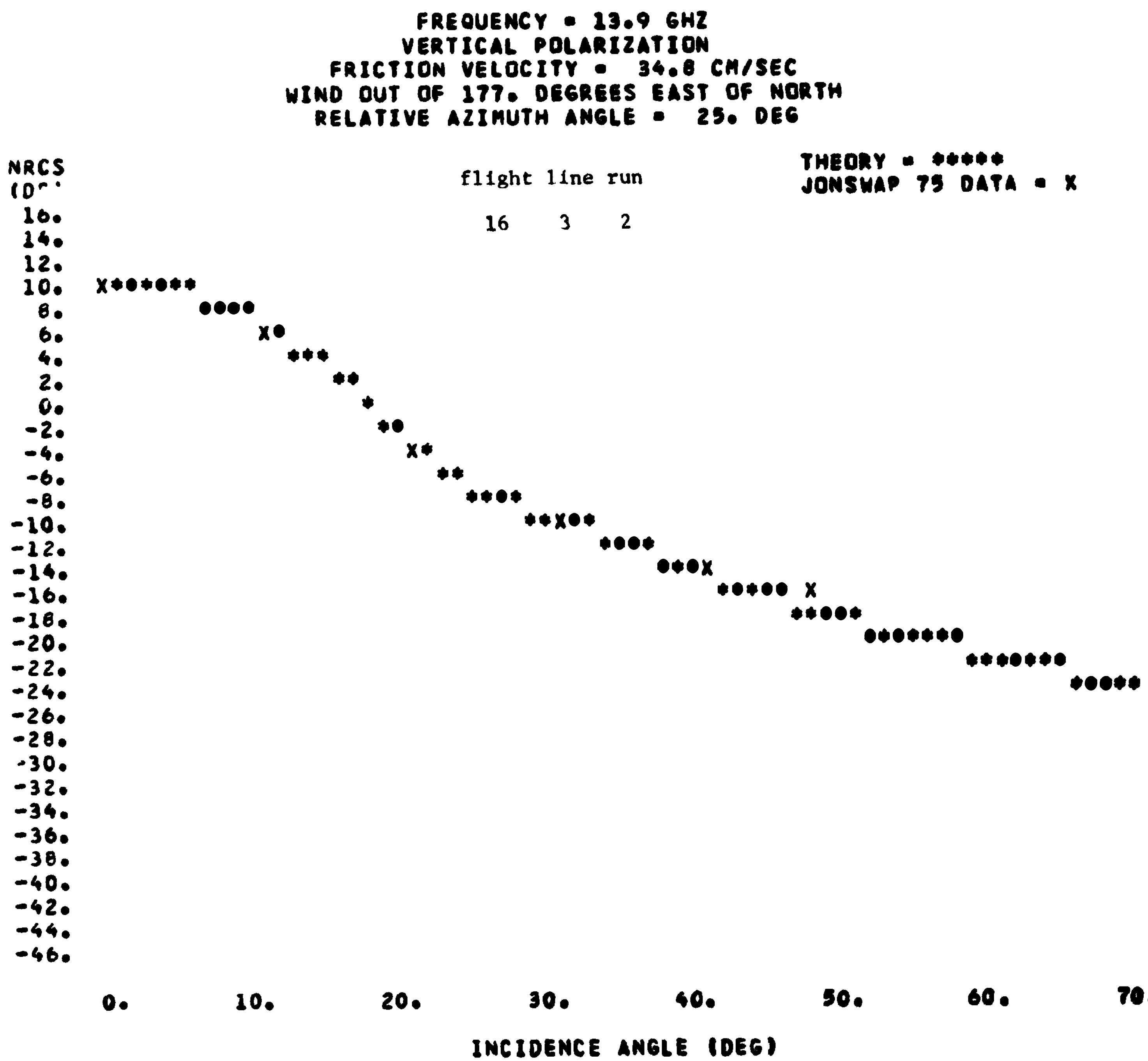
FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 30.1 CM/SEC
WIND OUT OF 226. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 76. DEG



NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 33.7 CM/SEC
WIND OUT OF 187. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 155. DEG

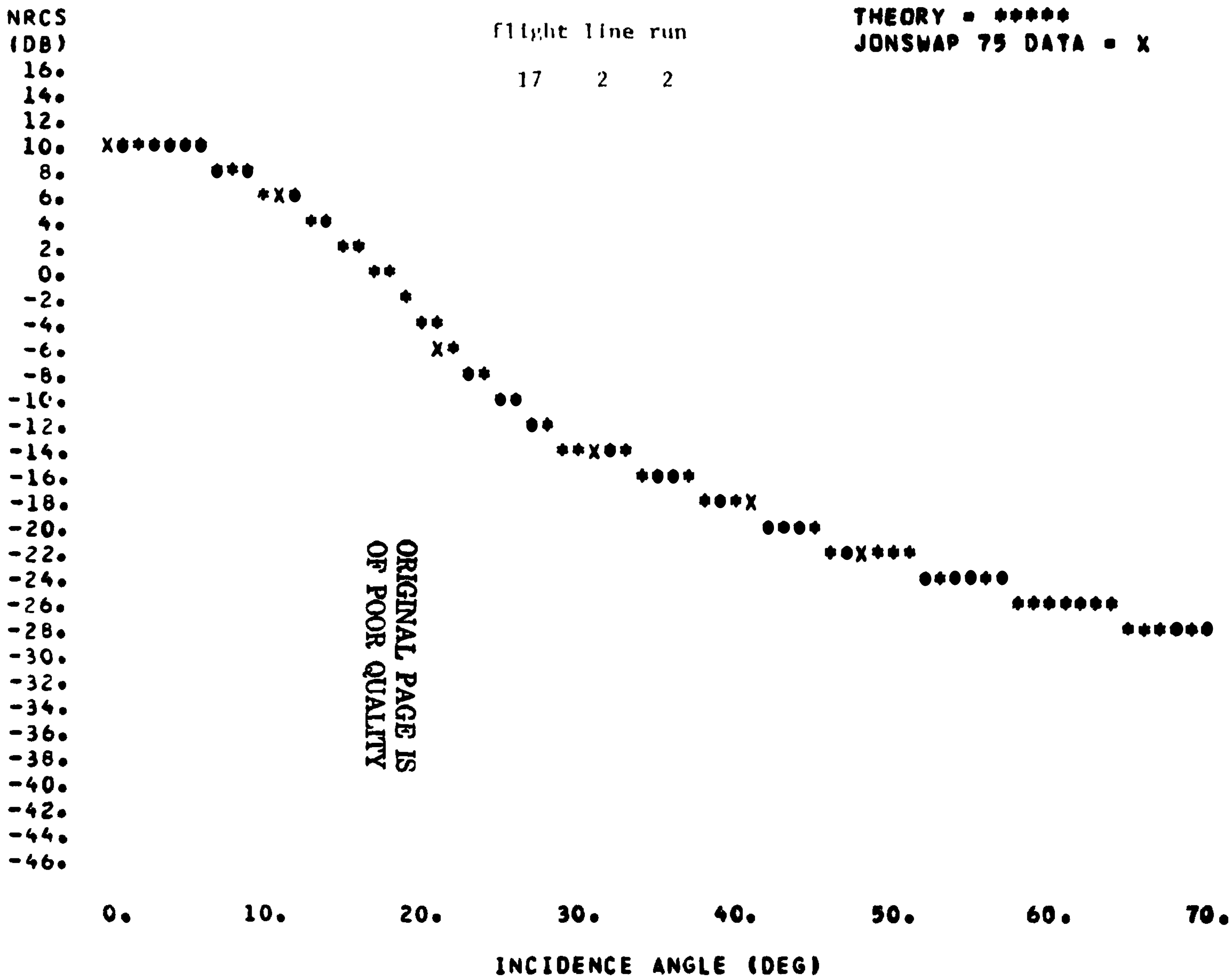




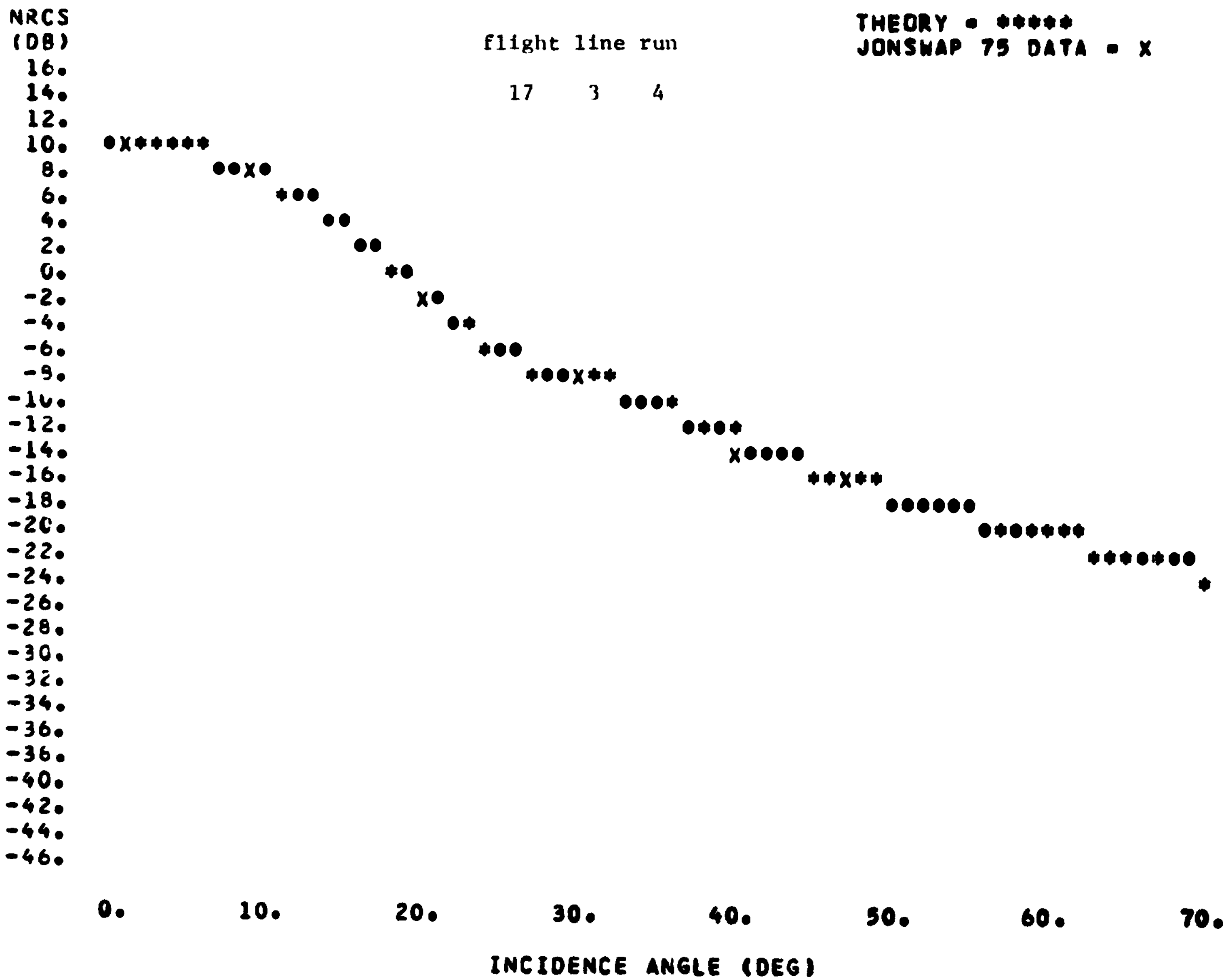
FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 34.8 CM/SEC
WIND OUT OF 177. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 25. DEG
THEORY = *****
JONSWAP 75 DATA = X
flight line run
16 3 2
NRCS
16.
14.
12.
10.
8.
6.
4.
2.
0.
-2.
-4.
-6.
-8.
-10.
-12.
-14.
-16.
-18.
-20.
-22.
-24.
-26.
-28.
-30.
-32.
-34.
-36.
-38.
-40.
-42.
-44.
-46.
0.
10.
20.
30.
40.
50.
60.
70.
INCIDENCE ANGLE (DEG)

NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 35.0 CM/SEC
WIND OUT OF 187. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 67. DEG

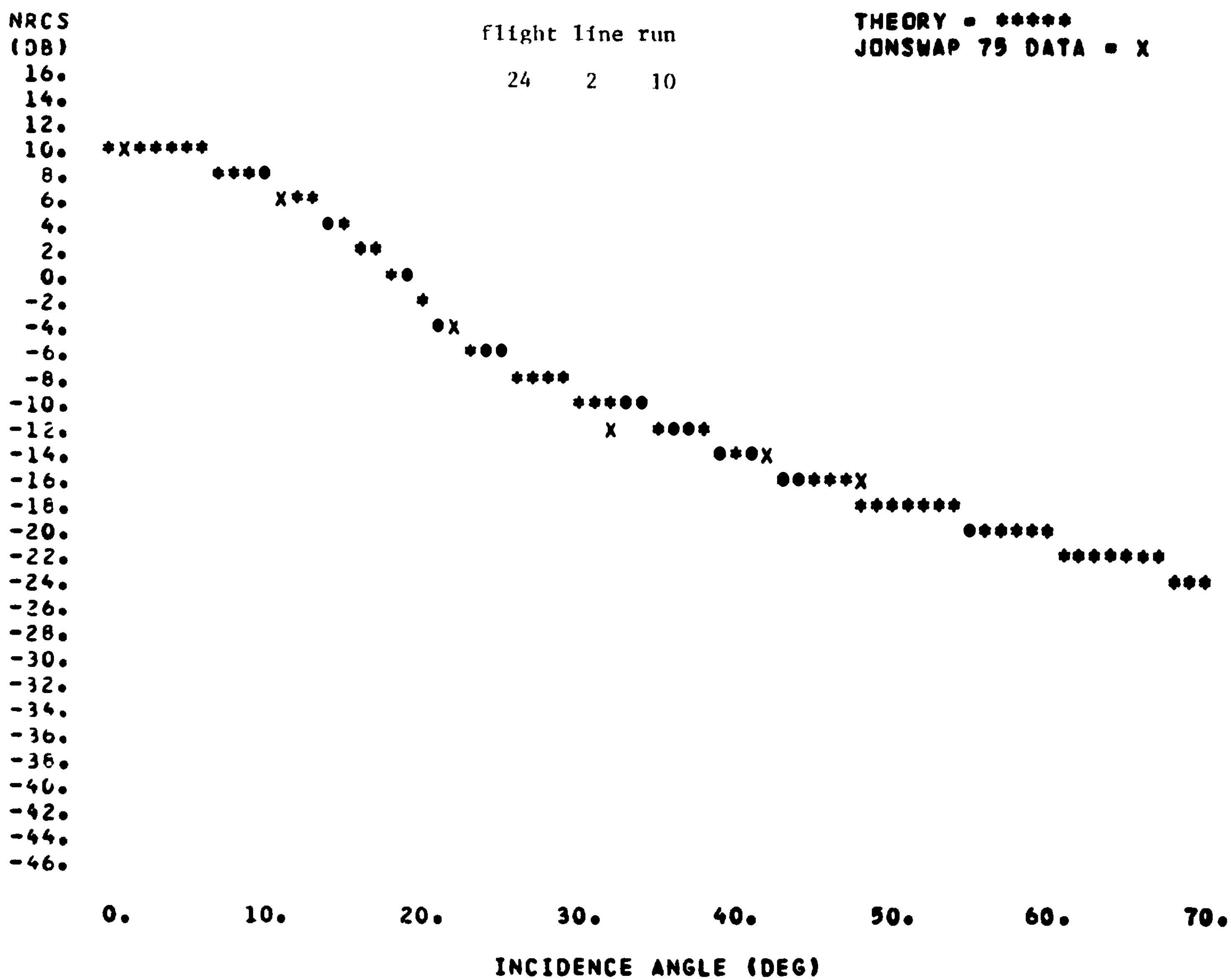


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 37.0 CM/SEC
WIND OUT OF 188. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 18. DEG

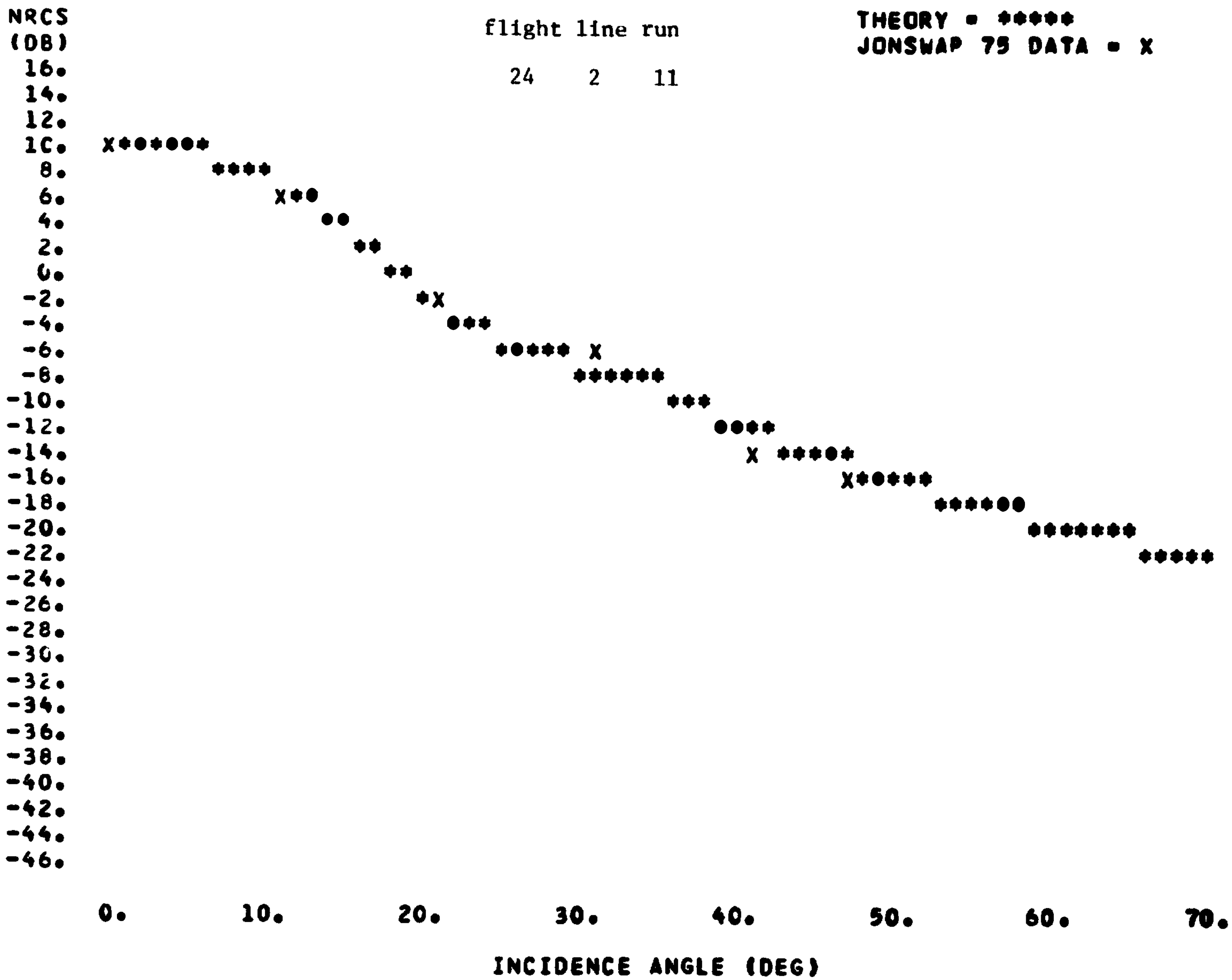


NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 37.4 CM/SEC
WIND OUT OF 229. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 177. DEG

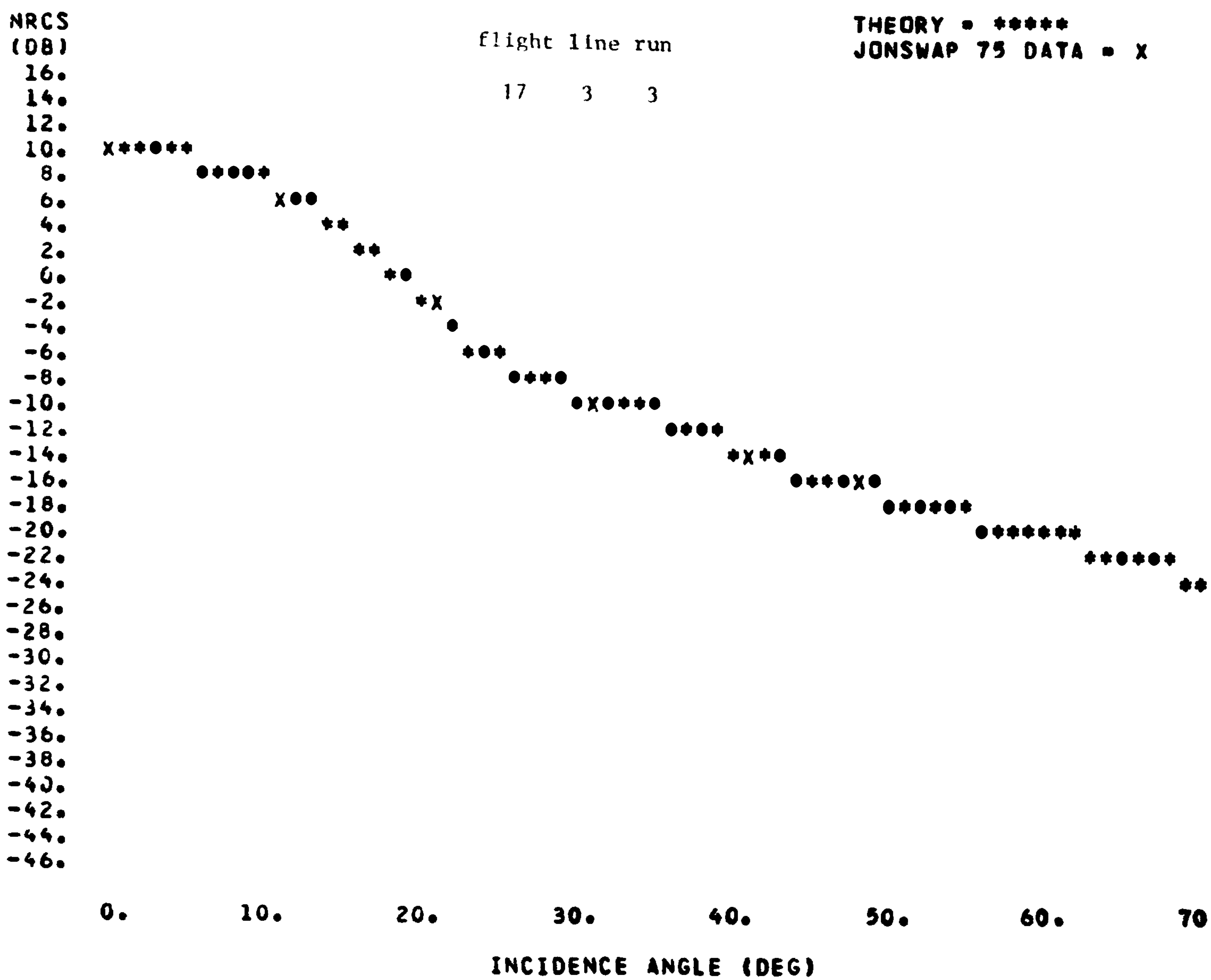


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 38.4 CM/SEC
WIND OUT OF 233. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 3. DEG

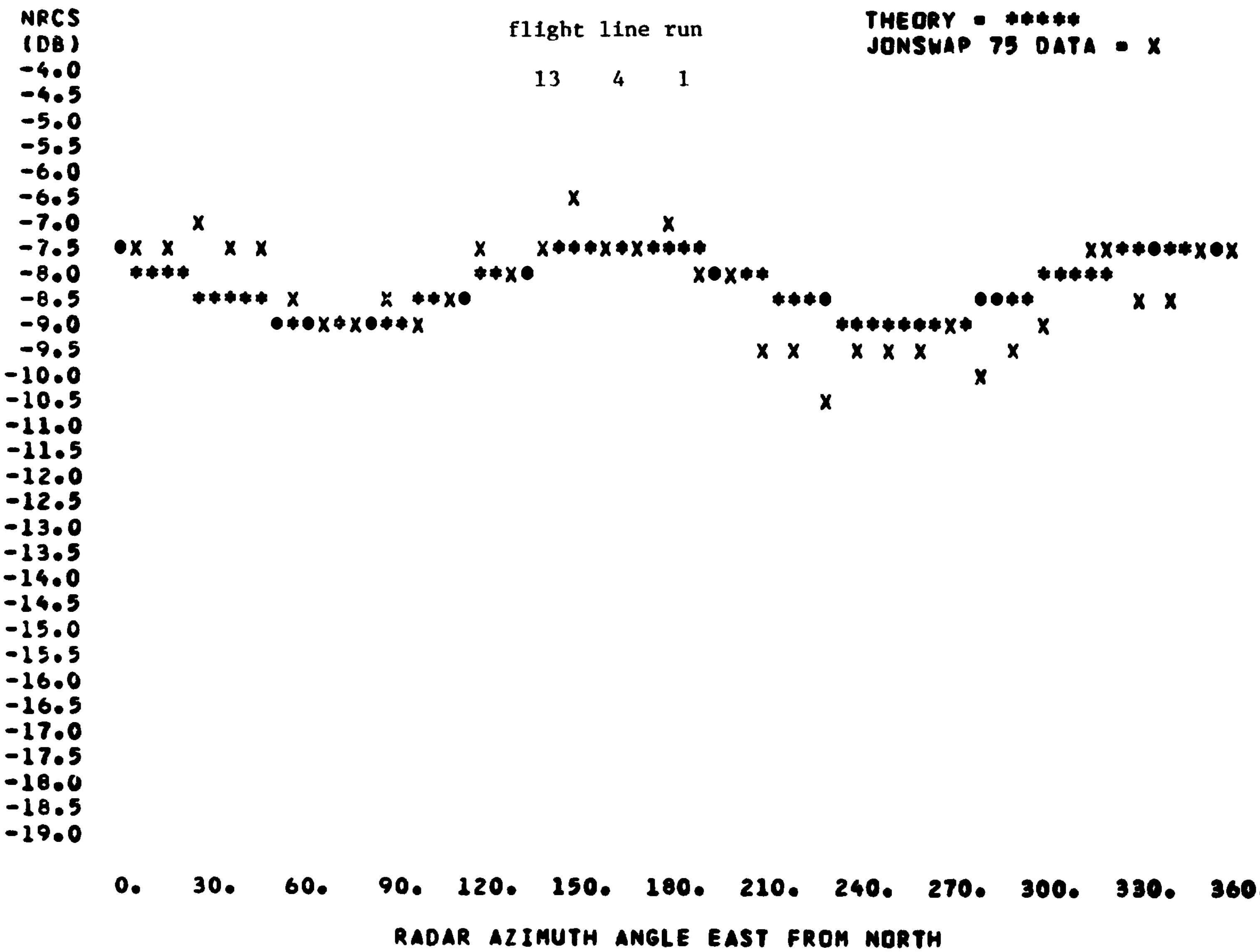


NRCS VERSUS INCIDENCE ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 39.6 CM/SEC
WIND OUT OF 189. DEGREES EAST OF NORTH
RELATIVE AZIMUTH ANGLE = 161. DEG

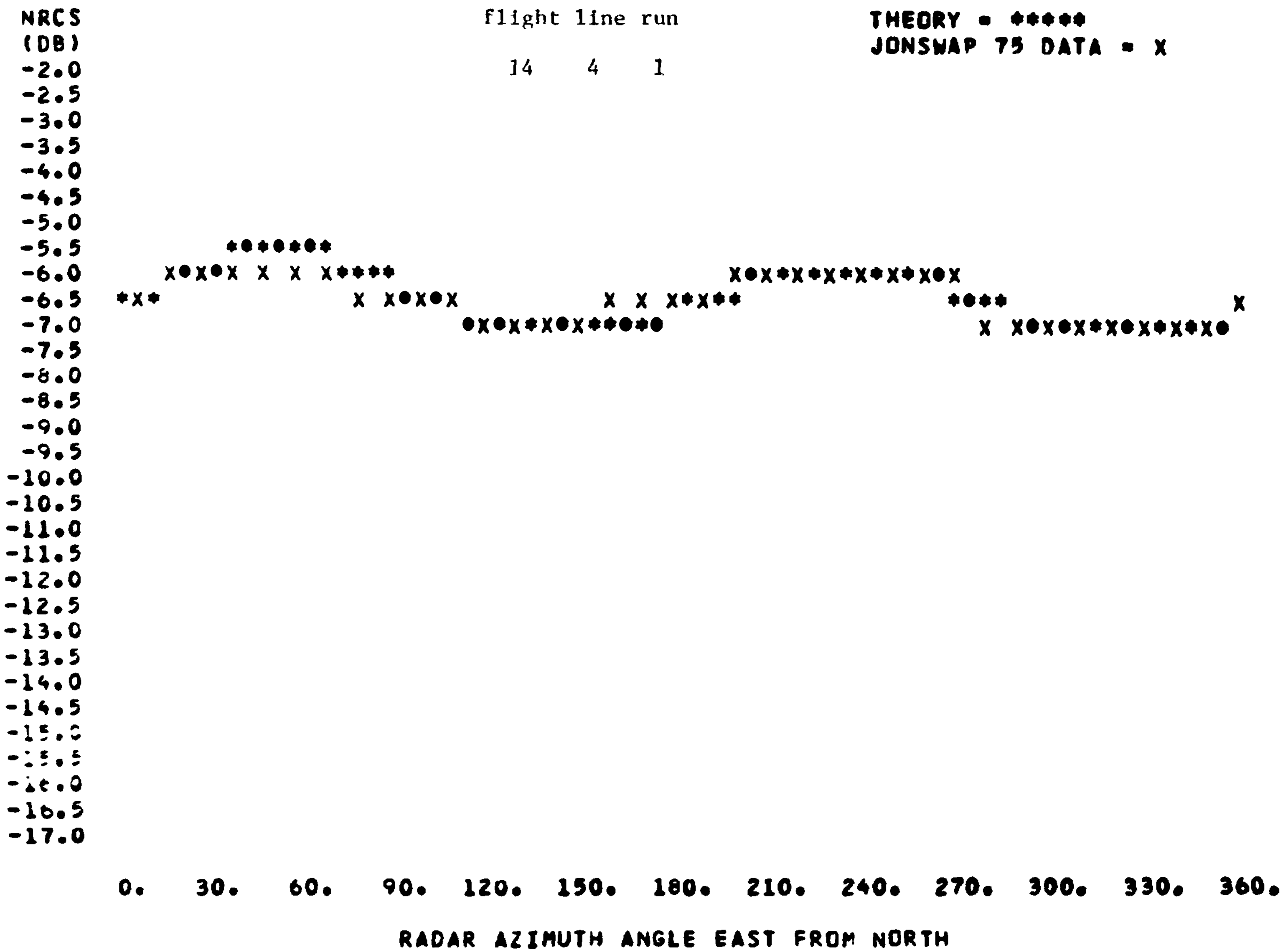


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 15.3 CM/SEC
WIND OUT OF 159. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG

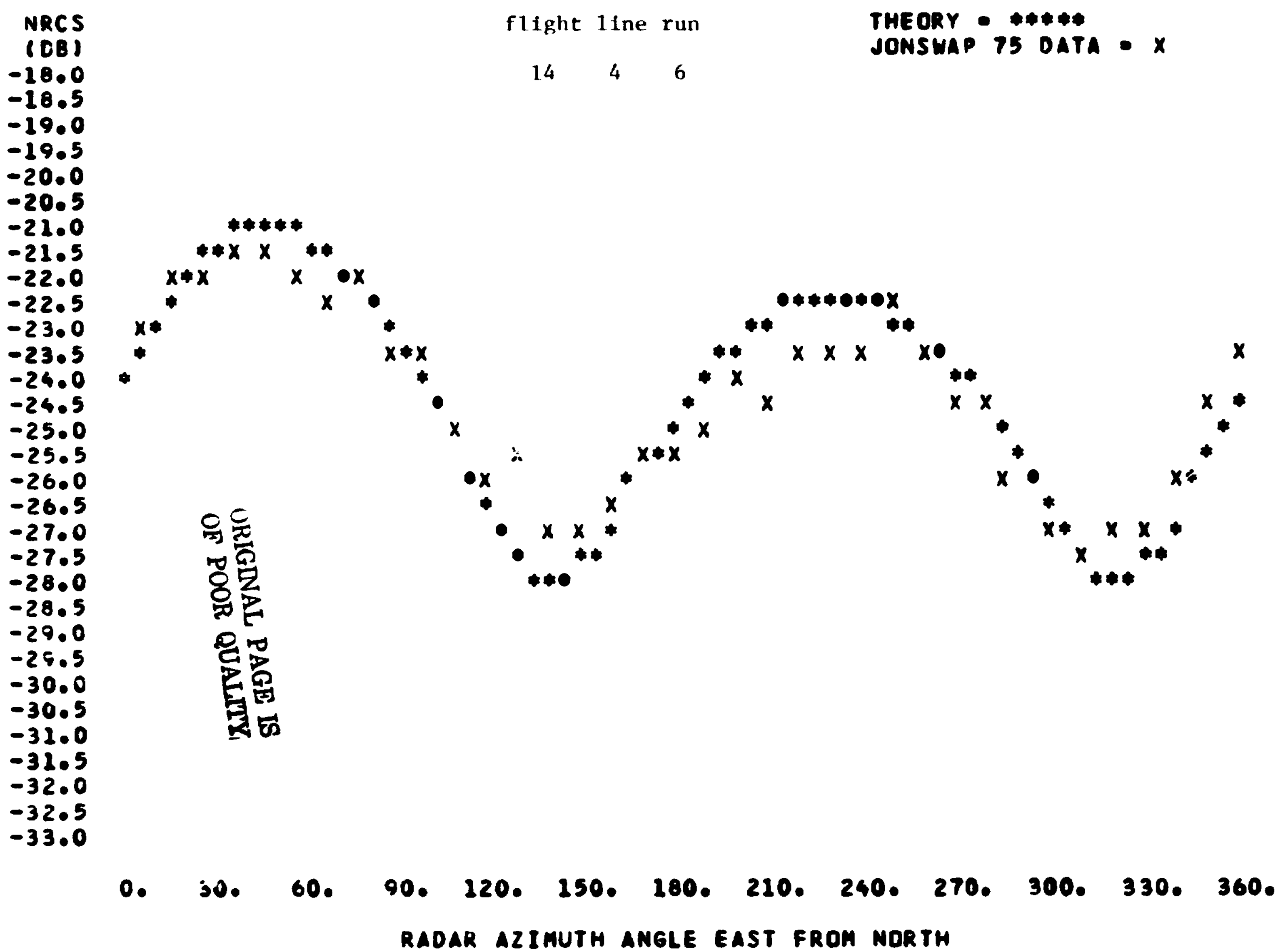


NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 19.1 CM/SEC
WIND OUT OF 50. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG



FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 20.3 CM/SEC
WIND OUT OF 46. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG



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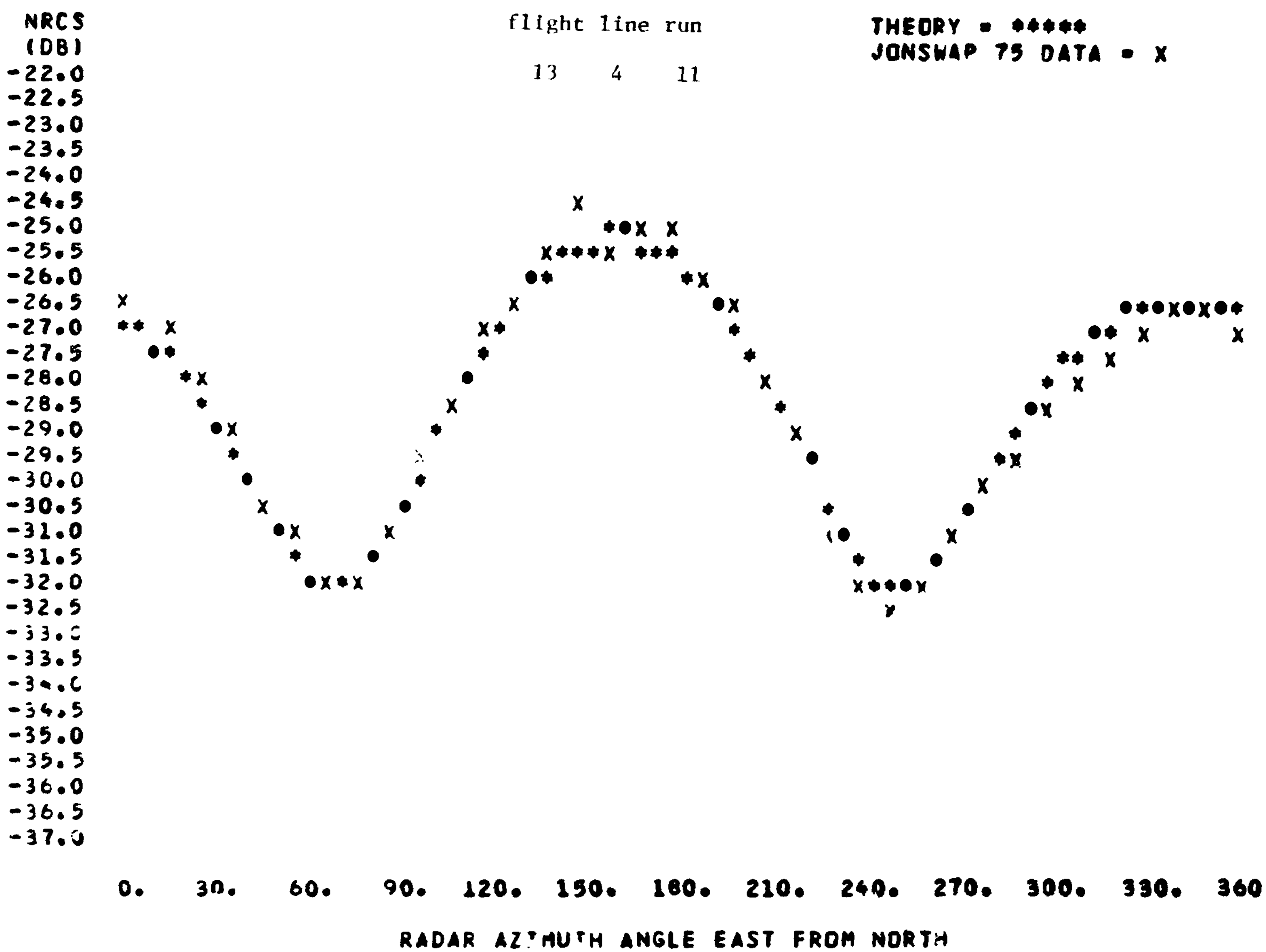
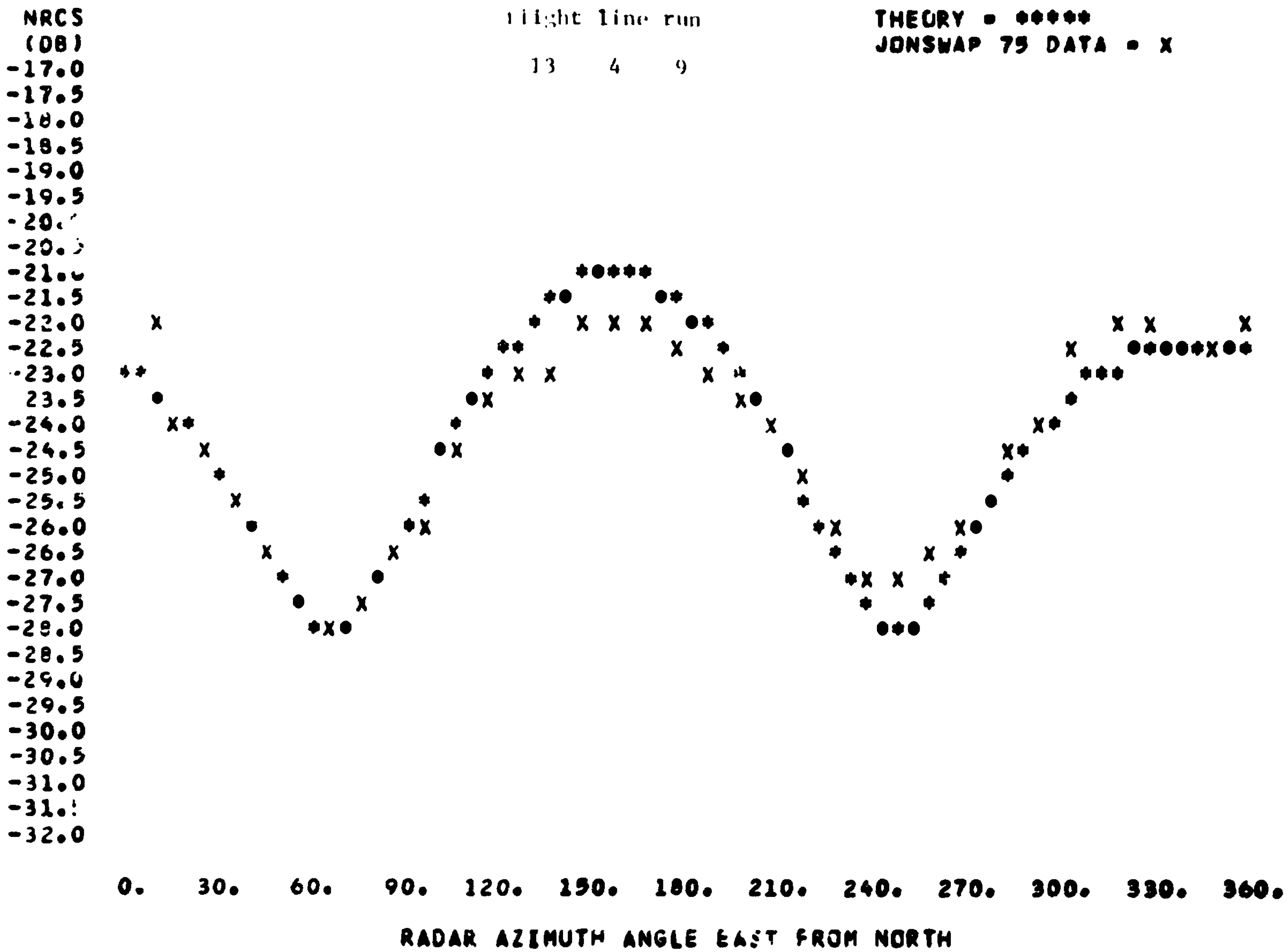
80

NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 20.3 CM/SEC
WIND OUT OF 158. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 50. DEG

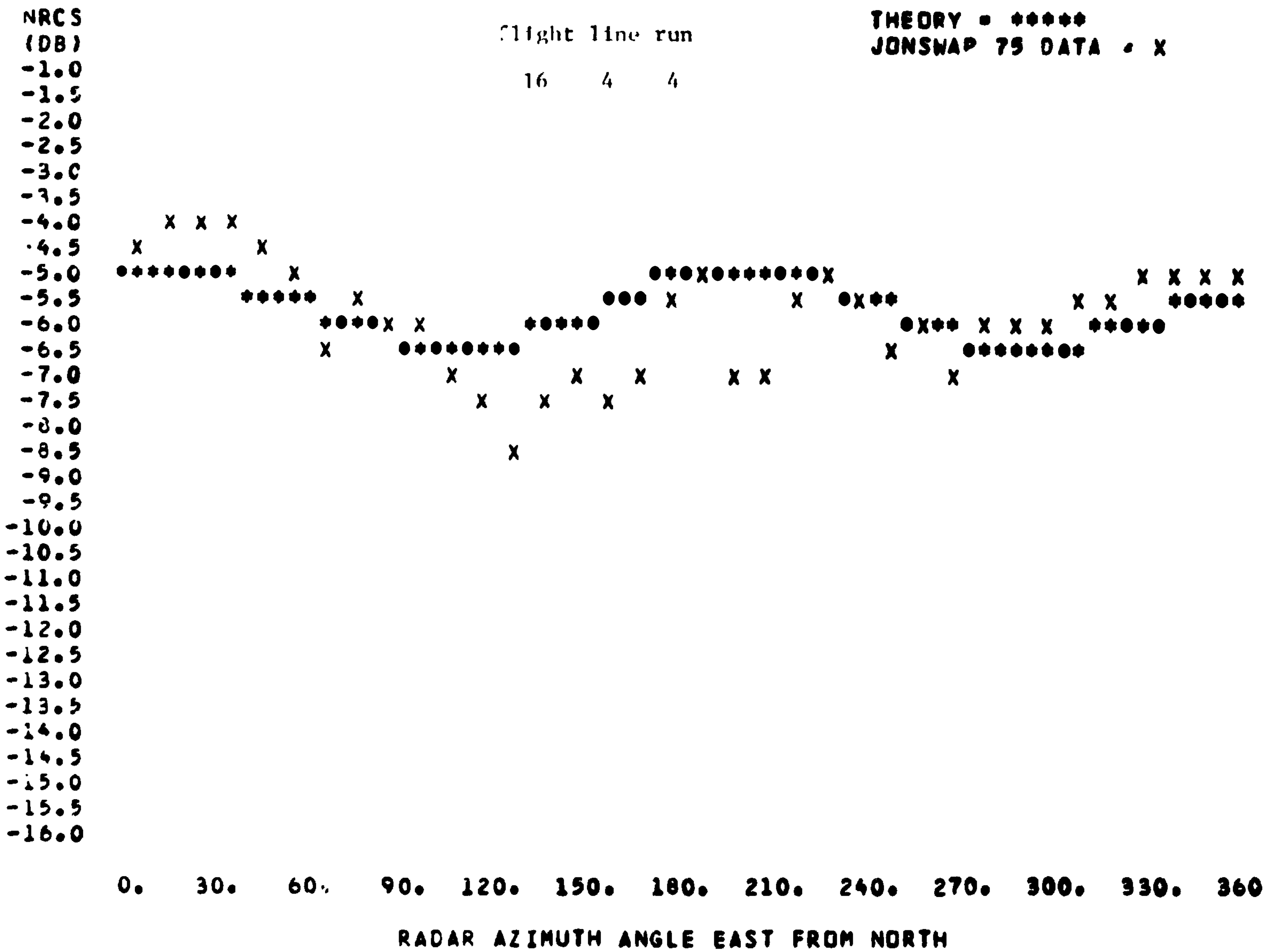


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 20.4 CM/SEC
WIND OUT OF 155. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG

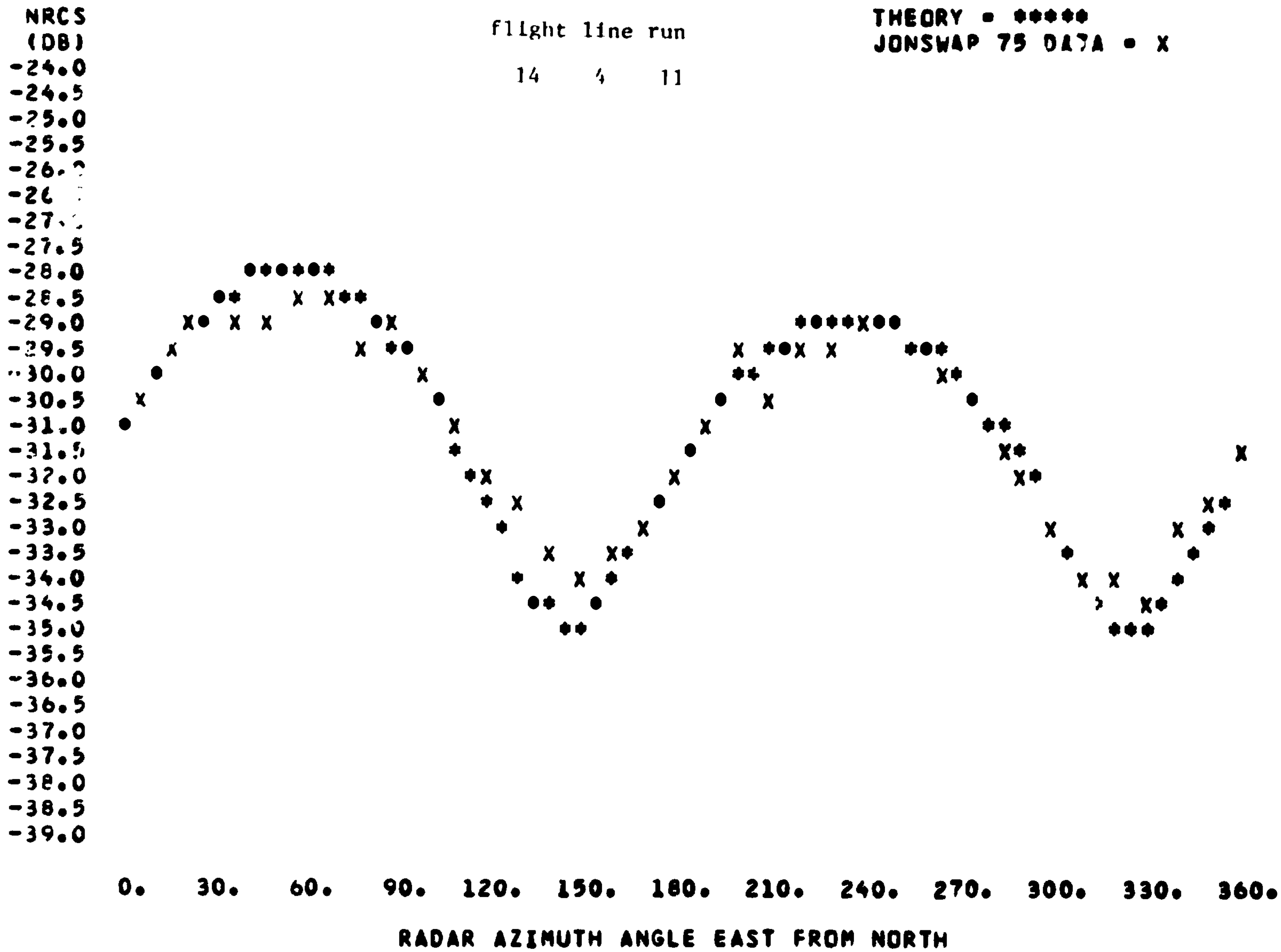


NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 21.5 CM/SEC
WIND OUT OF 198. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG

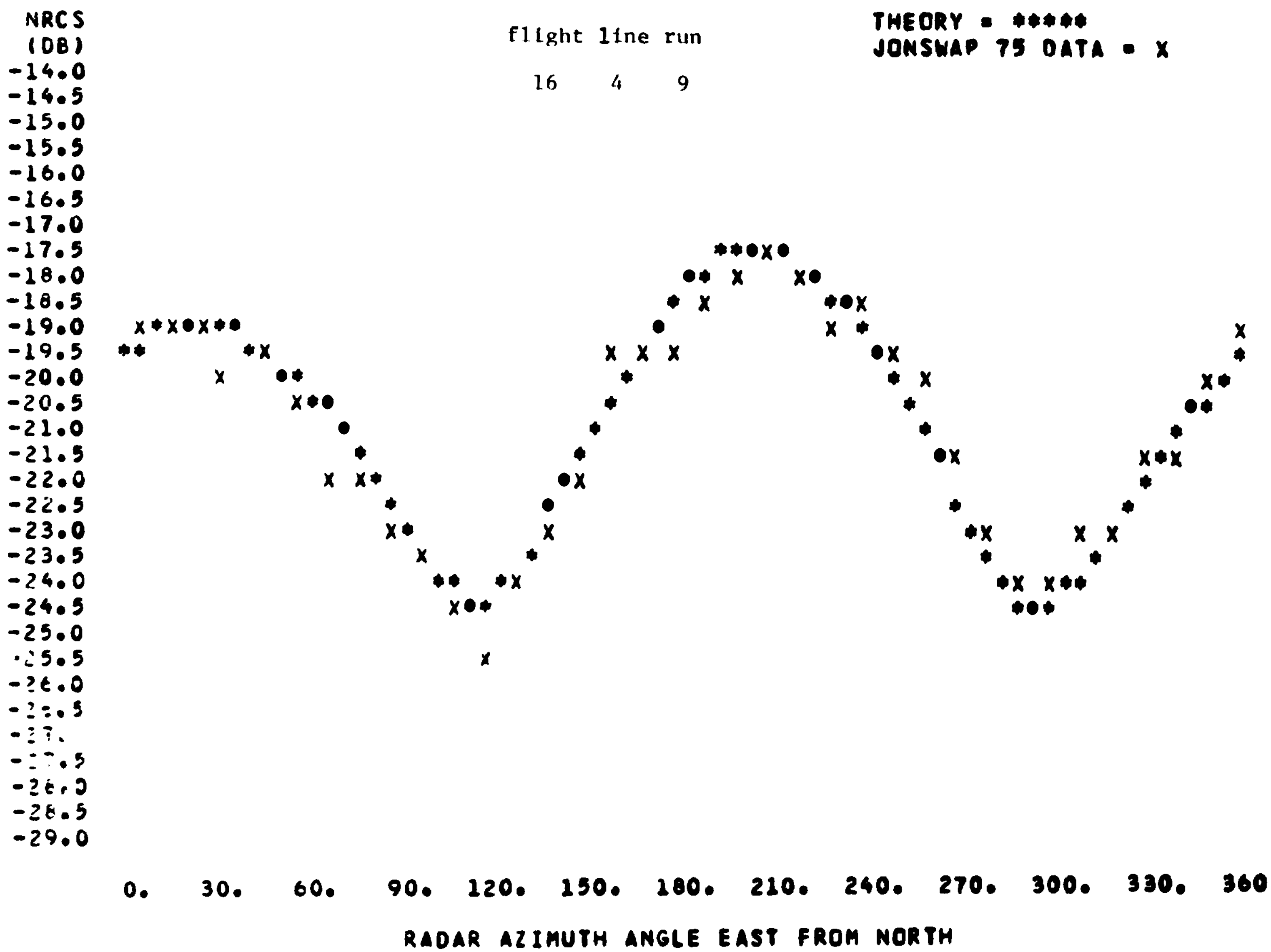


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 23.1 CM/SEC
WIND OUT OF 51. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG

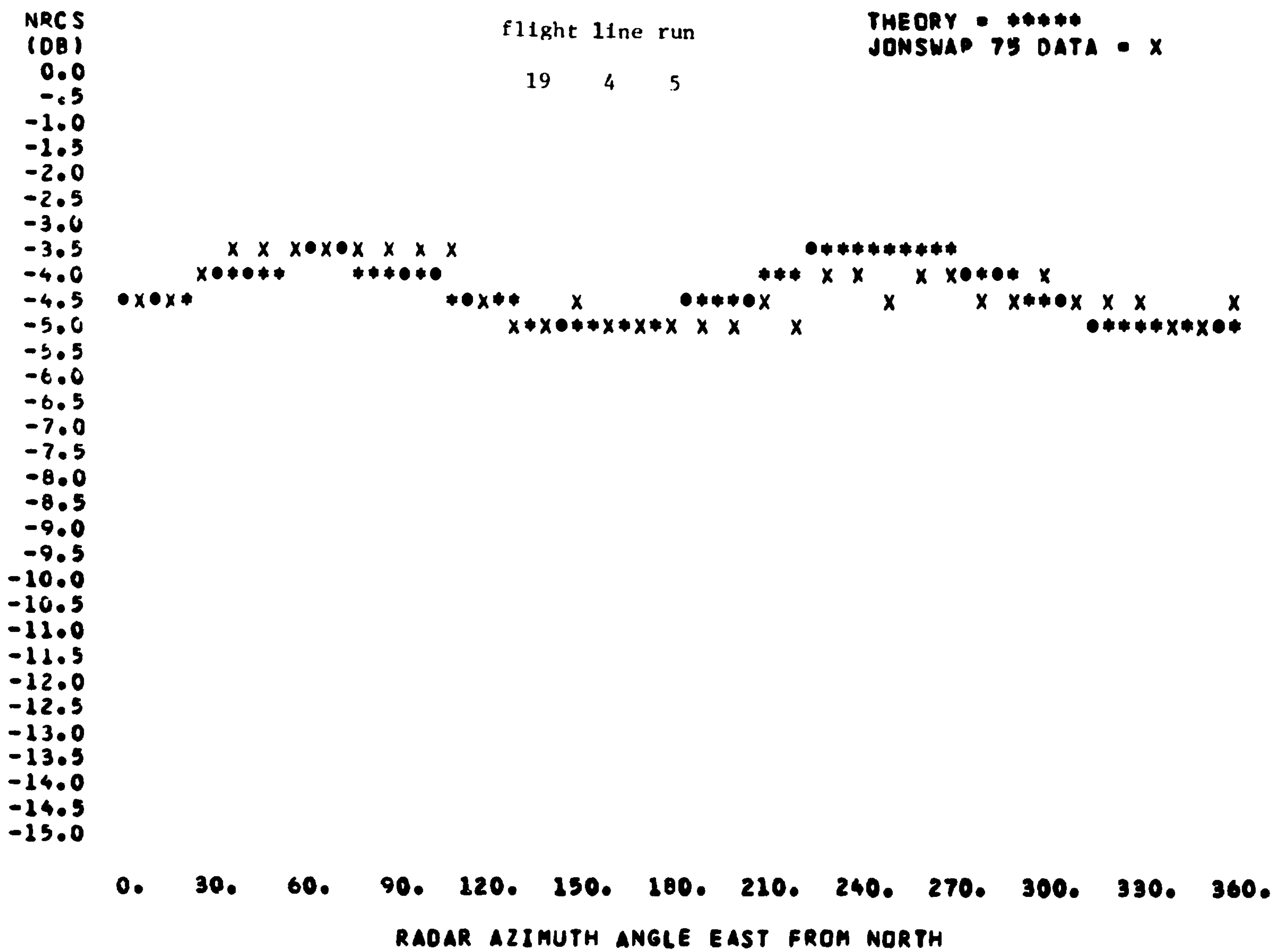


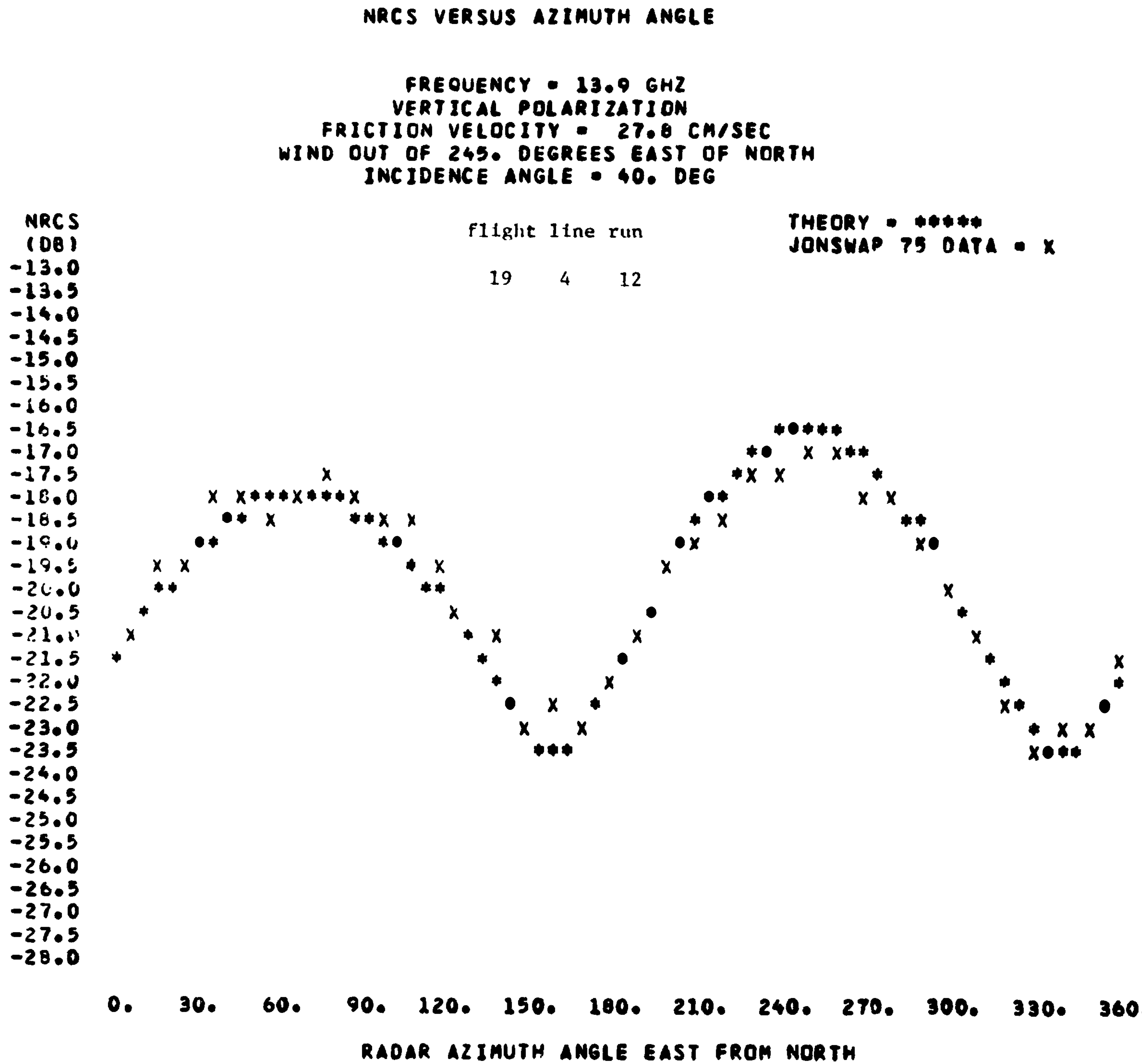
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 25.9 CM/SEC
WIND OUT OF 202. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG

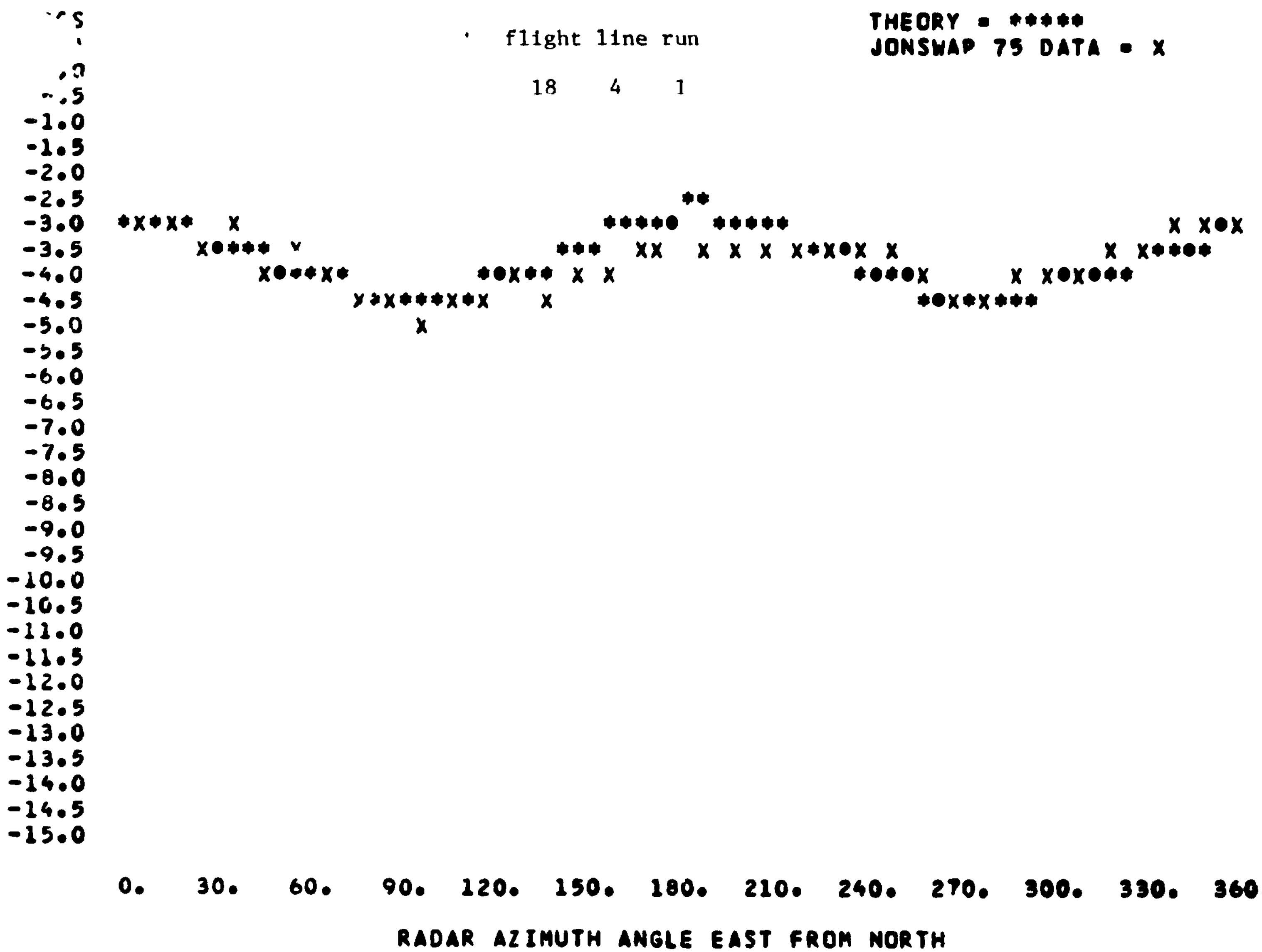


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 26.8 CM/SEC
WIND OUT OF 243. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG



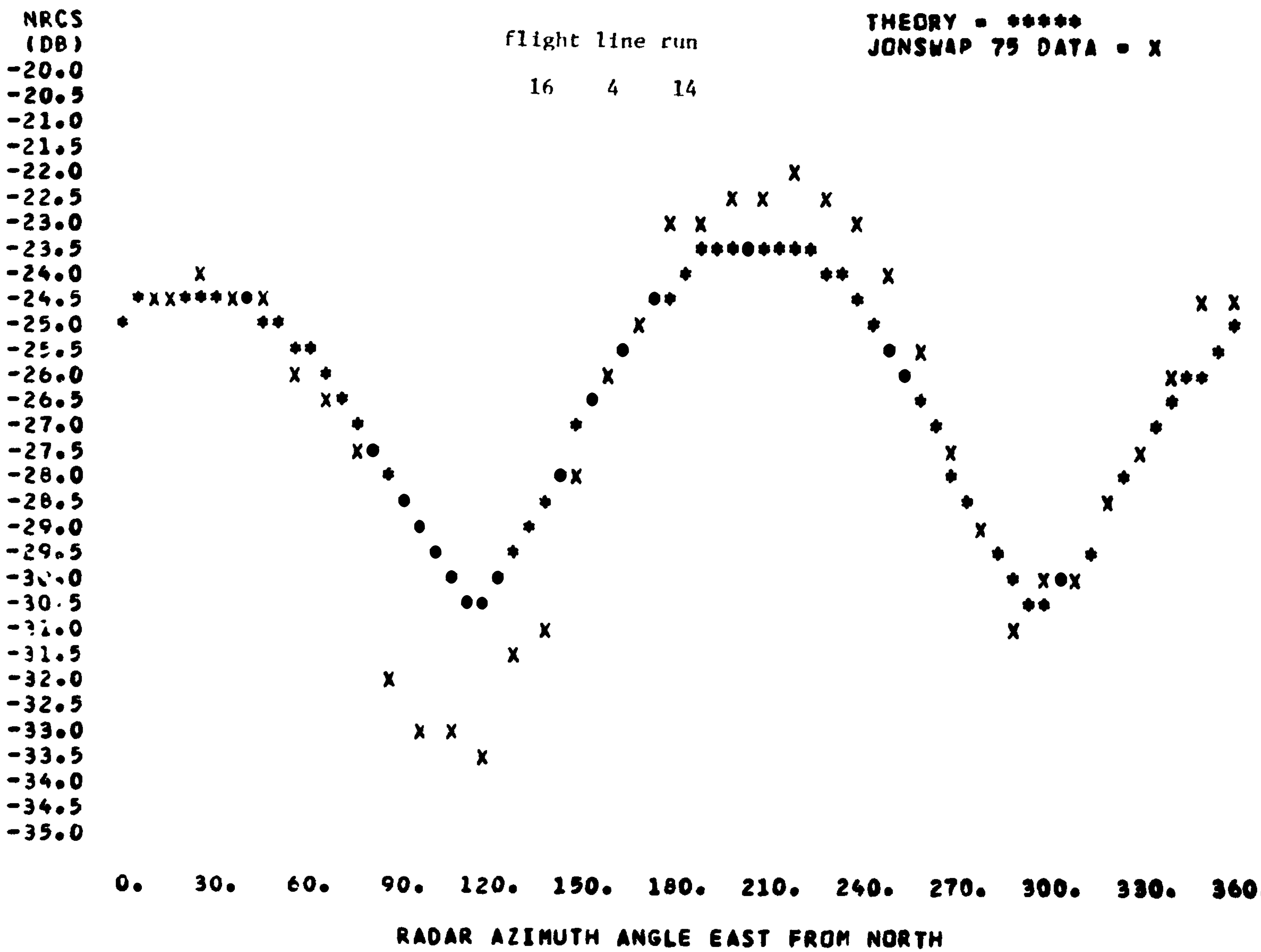

NRCS VERSUS AZIMUTH ANGLE
FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 27.8 CM/SEC
WIND OUT OF 245. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG
NRCS
(DB)
flight line run
19 4 12
THEORY = *****
JONSWAP 75 DATA = X
-13.0
-13.5
-14.0
-14.5
-15.0
-15.5
-16.0
-16.5
-17.0
-17.5
-18.0
-18.5
-19.0
-19.5
-20.0
-20.5
-21.0
-21.5
-22.0
-22.5
-23.0
-23.5
-24.0
-24.5
-25.0
-25.5
-26.0
-26.5
-27.0
-27.5
-28.0
0. 30. 60. 90. 120. 150. 180. 210. 240. 270. 300. 330. 360.
RADAR AZIMUTH ANGLE EAST FROM NORTH

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 29.9 CM/SEC
WIND OUT OF 183. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG

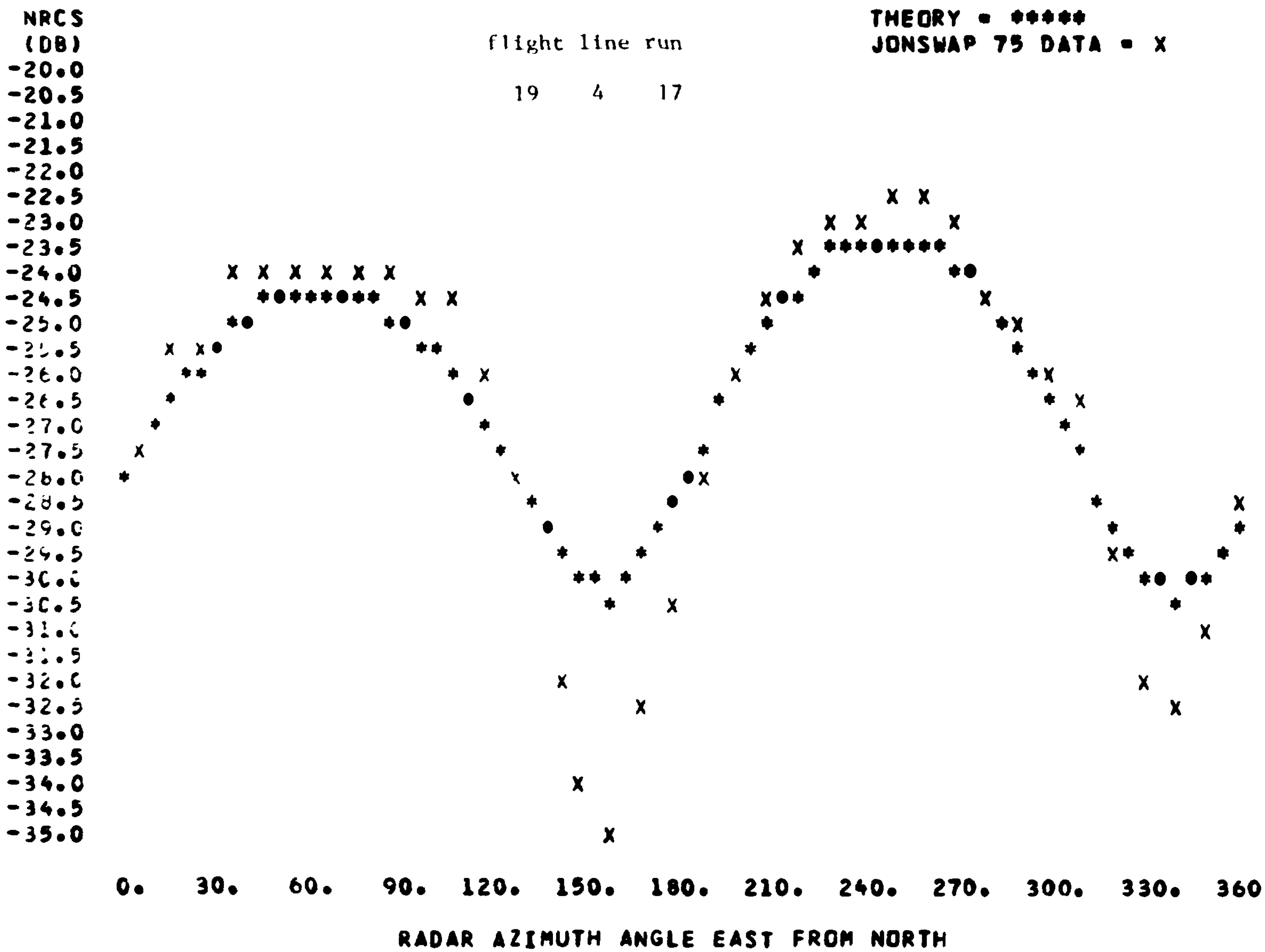


NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 31.9 CM/SEC
WIND OUT OF 203. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG

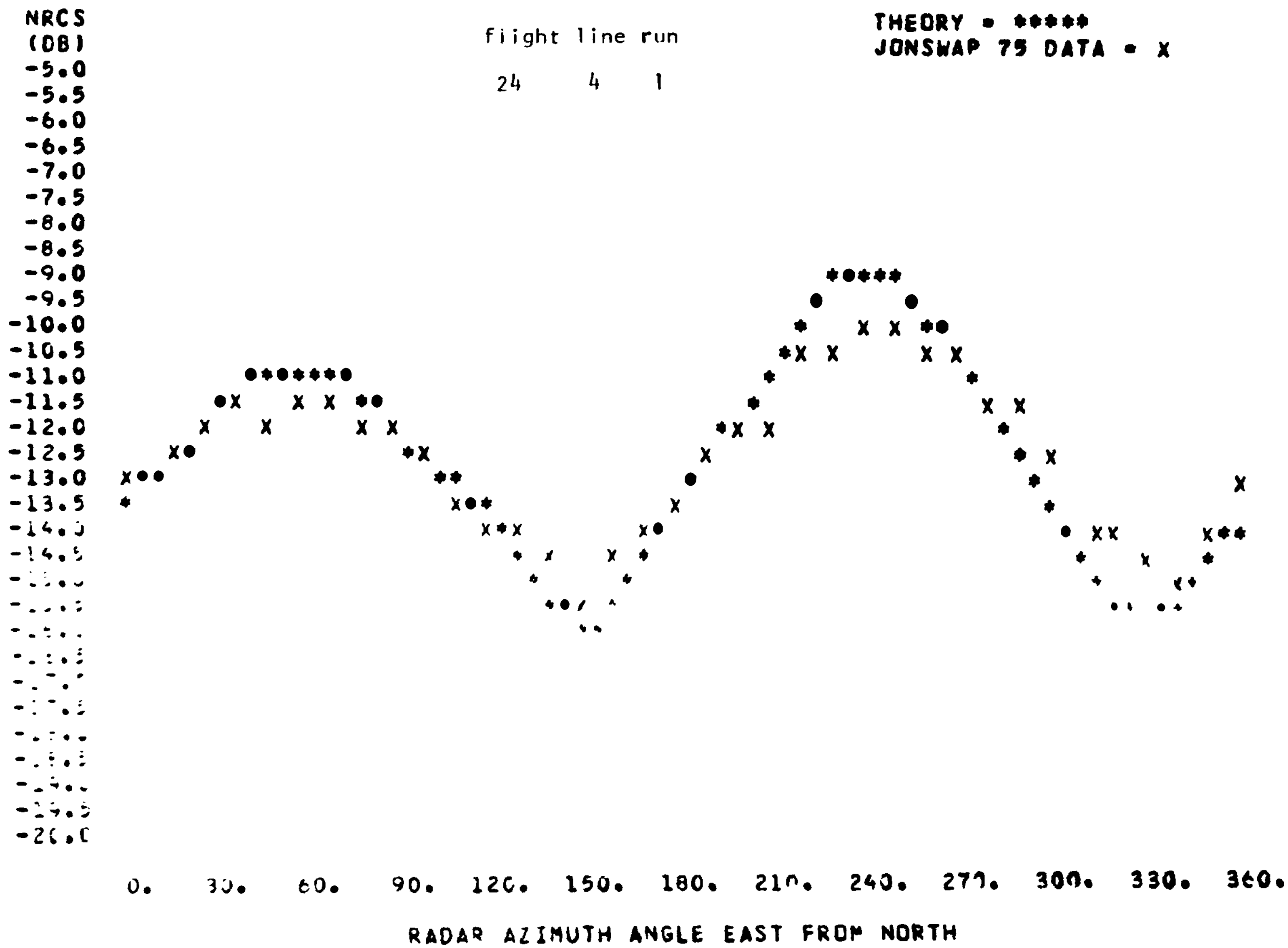


FREQUENCY = ’3.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 32.0 CM/SEC
WIND OUT OF 244. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG

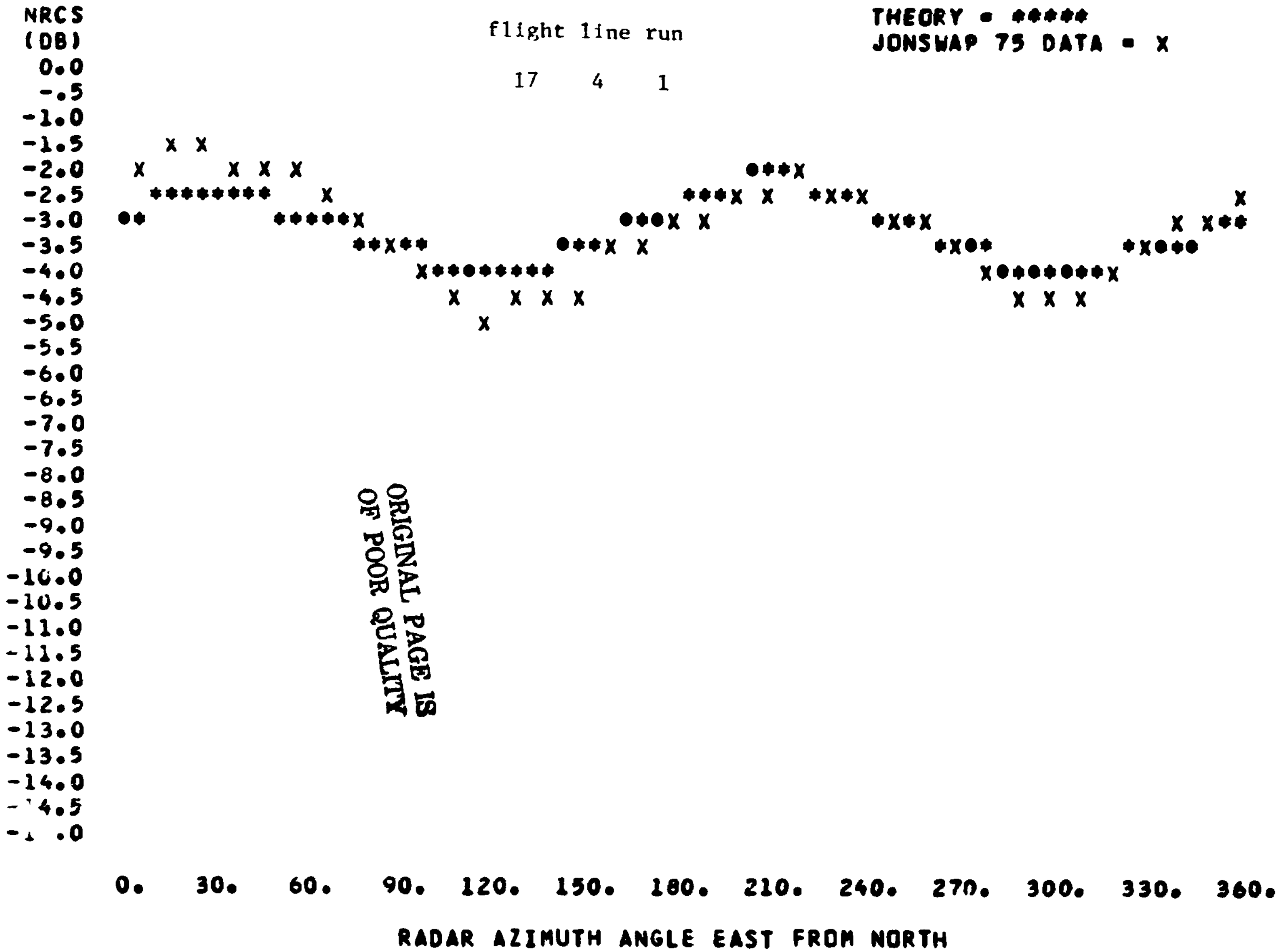


NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 33.1 CM/SEC
WIND OUT OF 236. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 30. DEG

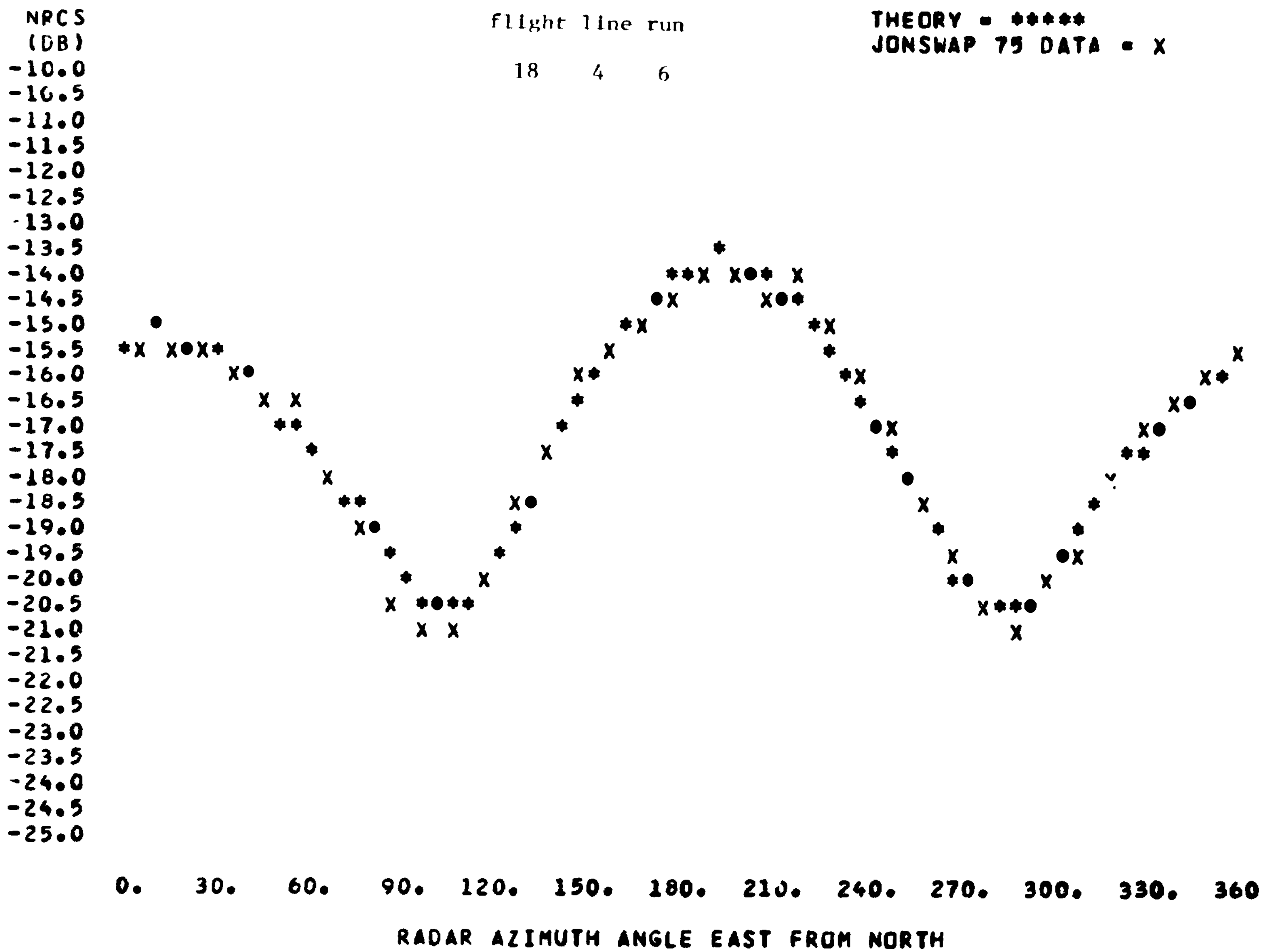


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 33.2 CM/SEC
WIND OUT OF 207. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 20. DEG

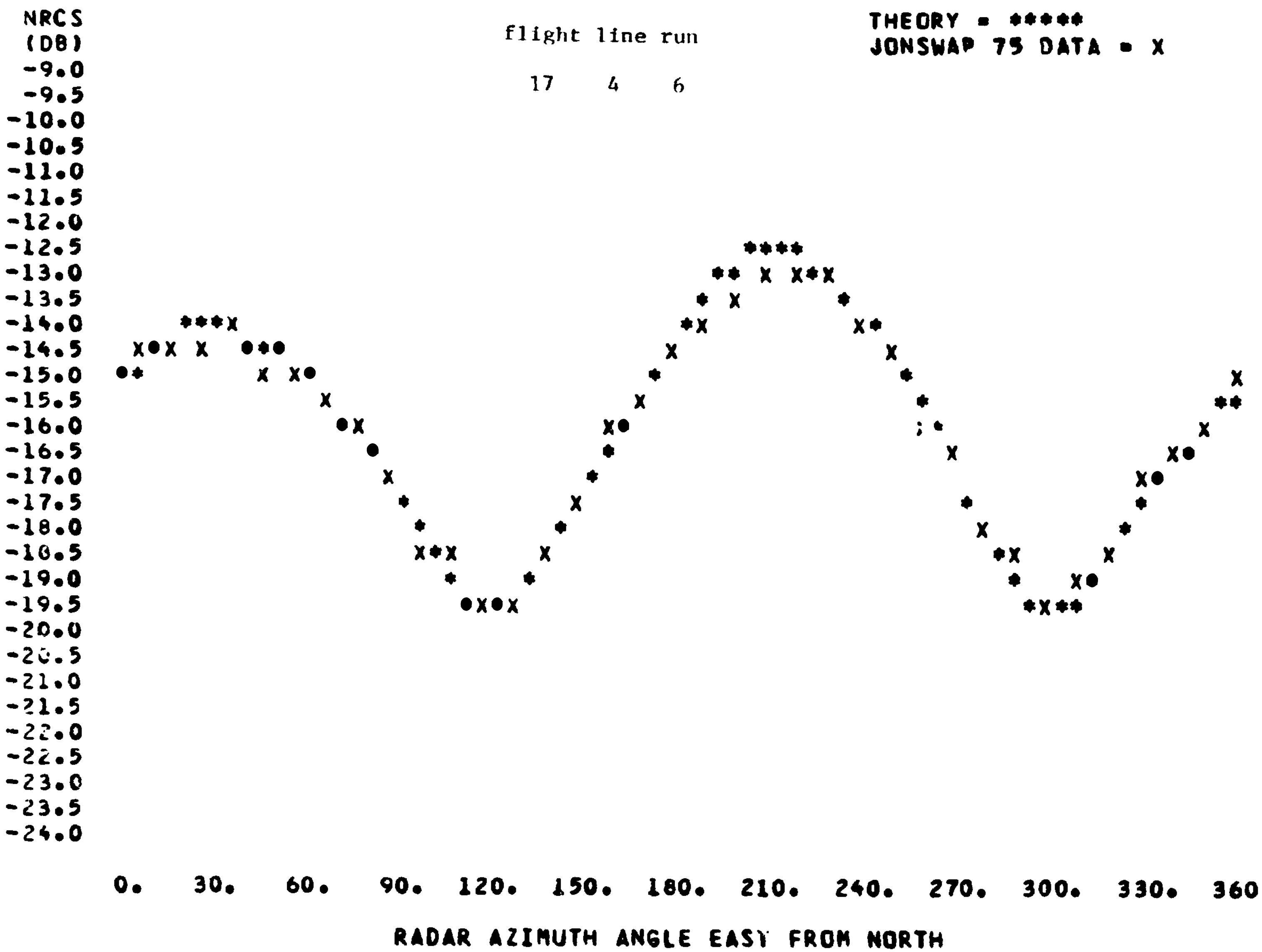


NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 33.5 CM/SEC
WIND OUT OF 191. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG

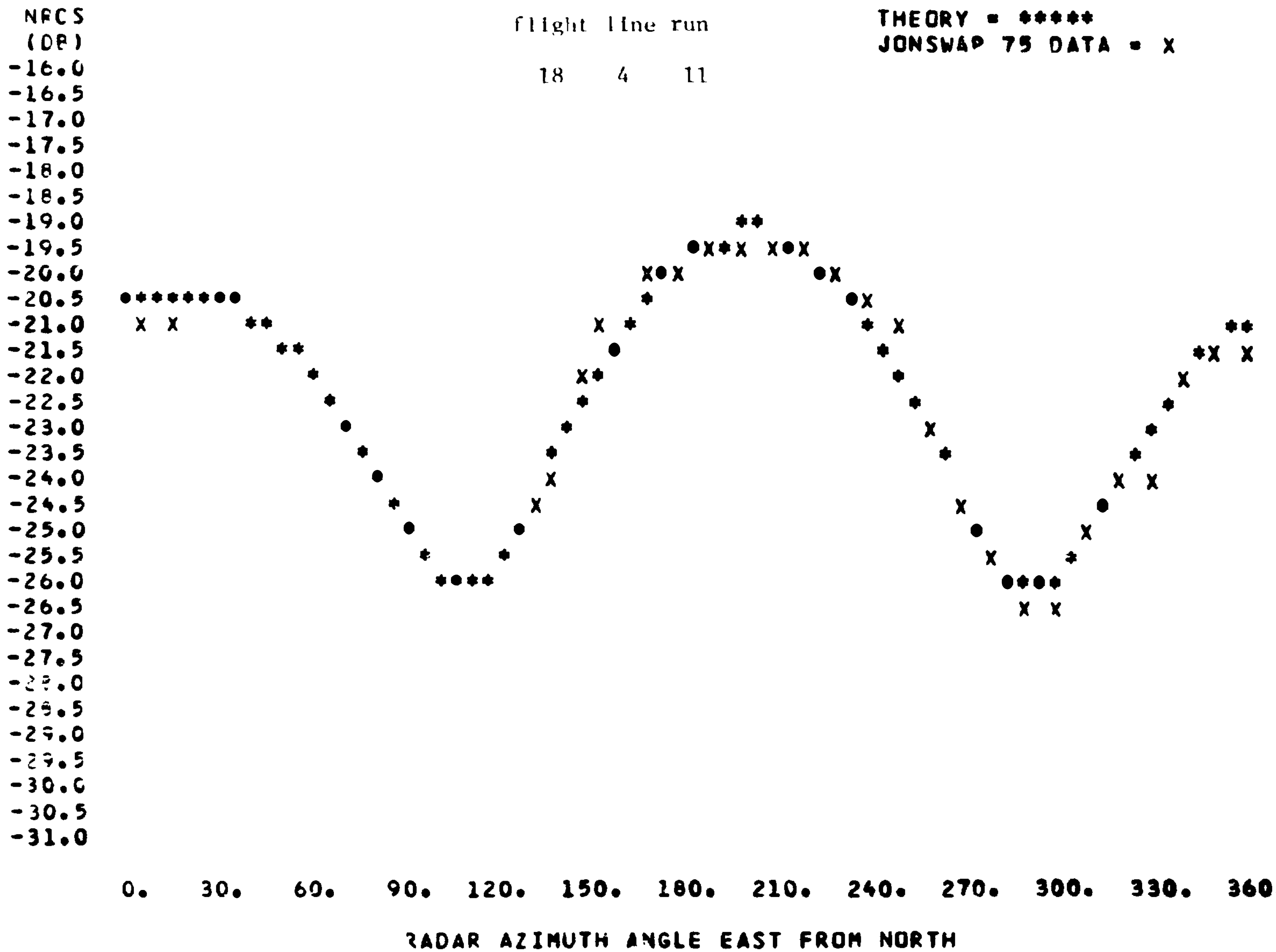


FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 36.1 CM/SEC
WIND OUT OF 208. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 40. DEG



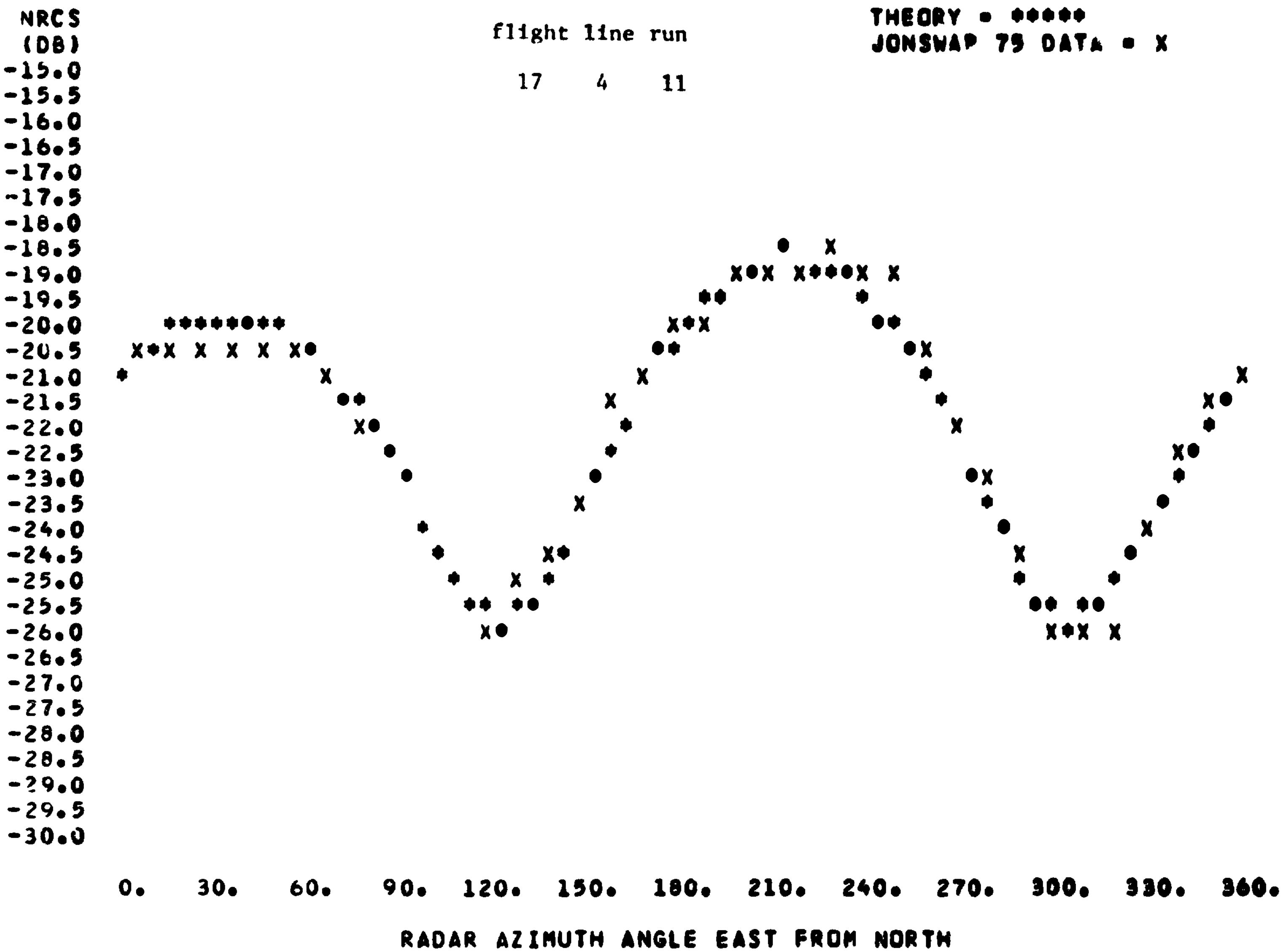
NRCS VERSUS AZIMUTH ANGLE

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 42.7 CM/SEC
WIND OUT OF 198. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG



C-2

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 44.2 CM/SEC
WIND OUT OF 211. DEGREES EAST OF NORTH
INCIDENCE ANGLE = 65. DEG



APPENDIX B

TABLES OF THE THEORETICAL NRCS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 5.0 CM/SEC

NCIDENCE GLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
2.0	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
4.0	13.4	13.4	13.4	13.4	13.4	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.4	13.4	13.4	13.4
6.0	11.7	11.7	11.7	11.7	11.6	11.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.6	11.6	11.7	11.7	11.7	11.7
8.0	9.3	9.3	9.3	9.2	9.2	9.1	9.0	9.0	9.0	8.9	9.0	9.0	9.0	9.1	9.2	9.2	9.3	9.3	9.3
10.0	6.2	6.2	6.2	6.1	6.0	5.9	5.8	5.7	5.6	5.6	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.2	6.2
12.0	2.4	2.4	2.3	2.2	2.0	1.9	1.7	1.6	1.5	1.5	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.4	2.4
14.0	-2.2	-2.2	-2.4	-2.5	-2.7	-3.0	-3.2	-3.3	-3.4	-3.5	-3.4	-3.3	-3.2	-3.0	-2.7	-2.5	-2.4	-2.3	-2.2
16.0	-7.6	-7.7	-7.8	-8.0	-8.3	-8.6	-8.9	-9.1	-9.3	-9.3	-9.3	-9.1	-8.9	-8.6	-8.4	-8.1	-7.9	-7.7	-7.7
18.0	-13.7	-13.7	-14.0	-14.3	-14.7	-15.1	-15.5	-15.8	-16.0	-16.0	-16.0	-15.8	-15.5	-15.2	-14.8	-14.5	-14.2	-14.0	-13.9
20.0	-19.9	-20.0	-20.3	-20.8	-21.4	-21.9	-22.4	-22.9	-23.2	-23.3	-23.2	-23.0	-22.6	-22.2	-21.8	-21.4	-21.1	-20.8	-20.8
22.0	-24.9	-25.1	-25.5	-26.2	-27.0	-27.7	-28.4	-29.1	-29.5	-29.8	-29.6	-29.3	-28.9	-28.5	-28.1	-27.8	-27.5	-27.2	-27.1
24.0	-28.2	-28.4	-28.9	-29.6	-30.4	-31.3	-32.1	-32.9	-33.5	-33.8	-33.7	-33.3	-32.9	-32.5	-32.2	-32.0	-31.7	-31.5	-31.5
26.0	-30.5	-30.7	-31.1	-31.6	-32.7	-33.5	-34.4	-35.3	-35.9	-36.2	-36.1	-35.7	-35.3	-34.9	-34.6	-34.4	-34.2	-34.0	-34.0
28.0	-32.4	-32.6	-33.0	-33.7	-34.5	-35.4	-36.3	-37.1	-37.8	-38.1	-38.0	-37.6	-37.1	-36.7	-36.4	-36.2	-36.0	-35.8	-35.8
30.0	-34.1	-34.3	-34.7	-35.3	-36.1	-37.0	-37.9	-38.8	-39.5	-39.8	-39.7	-39.3	-38.8	-38.4	-38.0	-37.8	-37.6	-37.4	-37.4
32.0	-35.9	-35.9	-36.3	-36.9	-37.7	-38.6	-39.5	-40.4	-41.1	-41.4	-41.3	-40.9	-40.4	-39.9	-39.6	-39.3	-39.1	-38.9	-38.9
34.0	-37.3	-37.4	-37.8	-38.4	-39.2	-40.1	-41.0	-41.9	-42.6	-42.9	-42.8	-42.4	-41.9	-41.4	-41.0	-40.7	-40.5	-40.4	-40.3
36.0	-38.8	-38.9	-39.3	-39.8	-40.6	-41.5	-42.4	-43.3	-44.0	-44.3	-44.2	-43.8	-43.3	-42.8	-42.4	-42.1	-41.9	-41.7	-41.7
38.0	-40.2	-40.3	-40.7	-41.2	-42.0	-42.9	-43.8	-44.7	-45.4	-45.7	-45.6	-45.2	-44.7	-44.2	-43.8	-43.4	-43.2	-43.1	-43.0
40.0	-41.5	-41.7	-42.0	-42.6	-43.3	-44.2	-45.1	-46.0	-46.7	-47.1	-47.0	-46.6	-46.0	-45.5	-45.1	-44.7	-44.5	-44.4	-44.3
42.0	-42.8	-43.0	-43.3	-43.9	-44.6	-45.5	-46.4	-47.3	-48.0	-48.4	-48.3	-47.9	-47.3	-46.8	-46.4	-46.0	-45.8	-45.6	-45.6
44.0	-44.1	-44.2	-44.6	-45.1	-45.9	-46.7	-47.7	-48.6	-49.3	-49.6	-49.6	-49.1	-48.6	-48.1	-47.6	-47.3	-47.0	-46.9	-46.8
46.0	-45.4	-45.5	-45.8	-46.4	-47.1	-48.0	-48.9	-49.8	-50.6	-50.9	-50.9	-50.4	-49.9	-49.3	-48.9	-48.5	-48.3	-48.1	-48.1
48.0	-46.6	-46.7	-47.1	-47.6	-48.3	-49.2	-50.1	-51.1	-51.8	-52.1	-52.1	-51.7	-51.1	-50.6	-50.1	-49.7	-49.5	-49.3	-49.3
50.0	-47.9	-48.0	-48.3	-48.8	-49.5	-50.4	-51.4	-52.3	-53.0	-53.4	-53.3	-52.9	-52.4	-51.8	-51.3	-51.0	-50.7	-50.6	-50.5
52.0	-49.1	-49.2	-49.5	-50.0	-50.8	-51.6	-52.6	-53.5	-54.2	-54.6	-54.5	-54.1	-53.6	-53.0	-52.6	-52.2	-52.0	-51.8	-51.8
54.0	-50.3	-50.4	-50.7	-51.3	-52.0	-52.8	-53.8	-54.7	-55.5	-55.8	-55.8	-55.4	-54.8	-54.3	-53.8	-53.5	-53.2	-53.0	-53.0
56.0	-51.5	-51.6	-52.0	-52.5	-53.2	-54.1	-55.0	-56.0	-56.7	-57.1	-57.0	-56.6	-56.1	-55.6	-55.1	-54.7	-54.5	-54.3	-54.3
58.0	-52.8	-52.9	-53.2	-53.7	-54.4	-55.3	-56.3	-57.2	-58.0	-58.3	-58.3	-57.9	-57.4	-56.8	-56.4	-56.0	-55.8	-55.6	-55.5
60.0	-54.0	-54.2	-54.5	-55.0	-55.7	-56.6	-57.5	-58.5	-59.2	-59.6	-59.6	-59.2	-58.7	-58.2	-57.7	-57.3	-57.1	-56.9	-56.9
62.0	-55.3	-55.5	-55.8	-56.3	-57.0	-57.9	-58.8	-59.8	-60.6	-61.0	-60.9	-60.6	-60.1	-59.5	-59.1	-58.7	-58.4	-58.3	-58.2
64.0	-56.7	-56.8	-57.1	-57.6	-58.3	-59.2	-60.2	-61.1	-61.9	-62.3	-62.3	-62.0	-61.5	-60.9	-60.5	-60.1	-59.9	-59.7	-59.7
66.0	-58.1	-58.2	-58.5	-59.0	-59.7	-60.6	-61.6	-62.5	-63.3	-63.8	-63.8	-63.4	-62.9	-62.4	-61.9	-61.6	-61.3	-61.2	-61.1
68.0	-59.5	-59.6	-59.9	-60.4	-61.2	-62.0	-63.0	-64.0	-64.8	-65.2	-65.2	-64.9	-64.4	-63.9	-63.5	-63.1	-62.9	-62.7	-62.7
70.0	-61.0	-61.1	-61.4	-62.0	-62.7	-63.6	-64.5	-65.5	-66.3	-66.8	-66.8	-66.5	-66.0	-65.5	-65.1	-64.7	-64.5	-64.4	-64.3

ORIGINAL PAGE IS OF POOR QUALITY

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 10.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
2.0	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
4.0	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
6.0	11.0	11.0	11.0	11.0	11.0	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	11.0	11.0	11.0	11.0	11.0
8.0	9.4	9.4	9.4	9.4	9.3	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3	9.3	9.4	9.4	9.4	9.4
10.0	7.4	7.4	7.3	7.3	7.2	7.1	7.1	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.2	7.3	7.3	7.4	7.4
12.0	4.8	4.8	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.2	4.2	4.3	4.4	4.5	4.6	4.7	4.7	4.8	4.8
14.0	1.8	1.7	1.6	1.5	1.4	1.2	1.1	1.0	.9	.9	.9	1.0	1.1	1.2	1.4	1.5	1.6	1.7	1.7
16.0	-1.8	-1.9	-2.0	-2.2	-2.3	-2.6	-2.7	-2.9	-3.0	-3.0	-3.0	-2.9	-2.7	-2.6	-2.4	-2.2	-2.0	-1.9	-1.9
18.0	-5.9	-6.0	-6.1	-6.4	-6.6	-6.9	-7.2	-7.4	-7.5	-7.5	-7.5	-7.4	-7.2	-6.9	-6.7	-6.5	-6.3	-6.2	-6.1
20.0	-10.4	-10.4	-10.7	-11.0	-11.4	-11.7	-12.1	-12.4	-12.6	-12.6	-12.6	-12.4	-12.2	-11.9	-11.6	-11.3	-11.1	-10.9	-10.8
22.0	-14.7	-14.8	-15.2	-15.7	-16.2	-16.7	-17.2	-17.6	-17.9	-18.0	-17.9	-17.7	-17.4	-17.1	-16.7	-16.4	-16.1	-15.9	-15.9
24.0	-18.3	-18.5	-18.9	-19.6	-20.3	-21.0	-21.7	-22.3	-22.7	-22.9	-22.8	-22.5	-22.1	-21.8	-21.5	-21.2	-20.9	-20.7	-20.6
26.0	-20.8	-21.0	-21.6	-22.3	-23.2	-24.0	-24.8	-25.5	-26.1	-26.3	-26.2	-25.9	-25.5	-25.2	-24.9	-24.7	-24.4	-24.2	-24.1
28.0	-22.9	-23.1	-23.6	-24.3	-25.2	-26.1	-26.9	-27.7	-28.4	-28.7	-28.6	-28.2	-27.8	-27.5	-27.2	-27.0	-26.8	-26.6	-26.6
30.0	-24.8	-25.0	-25.4	-26.1	-27.0	-27.9	-28.8	-29.6	-30.3	-30.6	-30.5	-30.1	-29.7	-29.3	-29.1	-28.9	-28.7	-28.5	-28.4
32.0	-26.5	-26.6	-27.1	-27.8	-28.6	-29.5	-30.4	-31.3	-31.9	-32.3	-32.2	-31.8	-31.3	-31.0	-30.7	-30.4	-30.2	-30.1	-30.0
34.0	-28.1	-28.2	-28.6	-29.3	-30.1	-31.0	-31.9	-32.8	-33.5	-33.8	-33.7	-33.3	-32.9	-32.5	-32.2	-31.9	-31.7	-31.6	-31.5
36.0	-29.6	-29.7	-30.1	-30.8	-31.6	-32.4	-33.4	-34.3	-35.0	-35.3	-35.2	-34.8	-34.3	-33.9	-33.6	-33.3	-33.1	-33.0	-32.9
38.0	-31.0	-31.1	-31.5	-32.2	-32.9	-33.8	-34.8	-35.7	-36.4	-36.7	-36.6	-36.2	-35.7	-35.3	-34.9	-34.7	-34.5	-34.3	-34.3
40.0	-32.4	-32.5	-32.9	-33.5	-34.3	-35.2	-36.1	-37.0	-37.7	-38.1	-38.0	-37.6	-37.1	-36.6	-36.3	-36.0	-35.8	-35.6	-35.6
42.0	-33.7	-33.8	-34.2	-34.8	-35.6	-36.5	-37.4	-38.3	-39.0	-39.4	-39.3	-38.9	-38.4	-37.9	-37.6	-37.3	-37.0	-36.9	-36.9
44.0	-35.0	-35.1	-35.5	-36.1	-36.8	-37.7	-38.7	-39.6	-40.3	-40.7	-40.6	-40.2	-39.7	-39.2	-38.8	-38.5	-38.3	-38.2	-38.1
46.0	-36.3	-36.4	-36.8	-37.3	-38.1	-39.0	-39.9	-40.8	-41.5	-41.9	-41.9	-41.5	-41.0	-40.5	-40.1	-39.8	-39.5	-39.4	-39.4
48.0	-37.5	-37.6	-38.0	-38.6	-39.3	-40.2	-41.1	-42.1	-42.8	-43.2	-43.1	-42.7	-42.2	-41.7	-41.3	-41.0	-40.8	-40.6	-40.6
50.0	-38.8	-38.9	-39.2	-39.8	-40.5	-41.4	-42.4	-43.3	-44.0	-44.4	-44.3	-44.0	-43.5	-43.0	-42.5	-42.2	-42.0	-41.8	-41.8
52.0	-40.0	-40.1	-40.4	-41.0	-41.7	-42.6	-43.6	-44.5	-45.3	-45.6	-45.6	-45.2	-44.7	-44.2	-43.8	-43.4	-43.2	-43.1	-43.0
54.0	-41.2	-41.3	-41.6	-42.2	-42.9	-43.8	-44.8	-45.7	-46.5	-46.9	-46.8	-46.5	-45.9	-45.4	-45.0	-44.7	-44.4	-44.3	-44.3
56.0	-42.4	-42.5	-42.9	-43.4	-44.1	-45.0	-46.0	-46.9	-47.7	-48.1	-48.1	-47.7	-47.2	-46.7	-46.3	-45.9	-45.7	-45.6	-45.5
58.0	-43.6	-43.8	-44.1	-44.6	-45.4	-46.2	-47.2	-48.2	-48.9	-49.3	-49.3	-49.0	-48.5	-48.0	-47.5	-47.2	-47.0	-46.8	-46.8
60.0	-44.9	-45.0	-45.3	-45.9	-46.6	-47.5	-48.5	-49.4	-50.2	-50.6	-50.6	-50.3	-49.8	-49.3	-48.8	-48.5	-48.3	-48.1	-48.1
62.0	-46.2	-46.3	-46.6	-47.2	-47.9	-48.8	-49.7	-50.7	-51.5	-51.9	-51.9	-51.6	-51.1	-50.6	-50.2	-49.8	-49.6	-49.5	-49.4
64.0	-47.5	-47.6	-47.9	-48.5	-49.2	-50.1	-51.0	-52.0	-52.9	-53.3	-53.3	-52.9	-52.4	-51.9	-51.5	-51.2	-51.0	-50.8	-50.8
66.0	-48.8	-48.9	-49.3	-49.8	-50.5	-51.4	-52.4	-53.4	-54.2	-54.6	-54.7	-54.3	-53.9	-53.4	-52.9	-52.6	-52.4	-52.3	-52.2
68.0	-50.2	-50.3	-50.7	-51.2	-51.9	-52.8	-53.8	-54.8	-55.6	-56.1	-56.1	-55.8	-55.3	-54.8	-54.4	-54.1	-53.9	-53.7	-53.7
70.0	-51.7	-51.8	-52.1	-52.7	-53.4	-54.3	-55.3	-56.3	-57.1	-57.6	-57.6	-57.3	-56.9	-56.4	-56.0	-55.6	-55.4	-55.3	-55.3

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 15.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
2.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
4.0	11.5	11.5	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.5	11.5
6.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.4	10.4	10.4	10.4	10.4	10.5	10.5	10.5	10.5	10.5	10.5	10.5
8.0	9.3	9.3	9.2	9.2	9.2	9.1	9.1	9.1	9.0	9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.3	9.3
10.0	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.2	7.2	7.2	7.3	7.3	7.4	7.4	7.5	7.5	7.6	7.6
12.0	5.5	5.5	5.5	5.4	5.3	5.2	5.1	5.1	5.0	5.0	5.0	5.1	5.1	5.2	5.3	5.4	5.4	5.5	5.5
14.0	3.0	3.0	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.3	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.0
16.0	.1	.1	.0	-.1	-.3	-.5	-.6	-.8	-.8	-.9	-.8	-.8	-.6	-.5	-.3	-.2	-.1	.0	.0
18.0	-3.1	-3.2	-3.3	-3.5	-3.8	-4.0	-4.2	-4.4	-4.5	-4.5	-4.5	-4.4	-4.2	-4.0	-3.8	-3.7	-3.5	-3.4	-3.3
20.0	-6.7	-6.8	-7.0	-7.3	-7.6	-7.9	-8.2	-8.4	-8.6	-8.7	-6.6	-8.5	-8.3	-8.0	-7.8	-7.6	-7.4	-7.2	-7.2
22.0	-10.3	-10.4	-10.7	-11.1	-11.6	-12.1	-12.4	-12.8	-13.0	-13.1	-13.0	-12.9	-12.6	-12.3	-12.1	-11.8	-11.5	-11.4	-11.3
24.0	-13.4	-13.6	-14.0	-14.6	-15.3	-15.9	-16.4	-16.9	-17.3	-17.4	-17.3	-17.1	-16.8	-16.5	-16.2	-15.9	-15.7	-15.5	-15.4
26.0	-15.8	-16.0	-16.5	-17.2	-18.0	-18.8	-19.5	-20.2	-20.7	-20.9	-20.8	-20.5	-20.1	-19.9	-19.6	-19.4	-19.1	-18.9	-18.8
28.0	-17.6	-17.8	-18.3	-19.1	-20.0	-20.8	-21.6	-22.4	-23.0	-23.3	-23.2	-22.8	-22.4	-22.2	-22.0	-21.8	-21.5	-21.3	-21.2
30.0	-19.3	-19.4	-20.0	-20.7	-21.6	-22.5	-23.4	-24.1	-24.8	-25.1	-25.0	-24.6	-24.2	-23.9	-23.7	-23.5	-23.3	-23.1	-23.1
32.0	-21.0	-21.2	-21.7	-22.4	-23.3	-24.2	-25.0	-25.9	-26.5	-26.9	-26.8	-26.4	-26.0	-25.6	-25.4	-25.2	-25.0	-24.8	-24.8
34.0	-22.6	-22.6	-23.3	-24.0	-24.8	-25.7	-26.6	-27.4	-28.1	-28.5	-28.4	-28.0	-27.5	-27.2	-26.9	-26.7	-26.5	-26.4	-26.3
36.0	-24.2	-24.3	-24.8	-25.4	-26.3	-27.1	-28.1	-29.9	-29.6	-30.0	-29.9	-29.5	-29.0	-28.7	-28.4	-28.1	-27.9	-27.8	-27.7
38.0	-25.6	-25.8	-26.2	-26.8	-27.6	-28.5	-29.5	-30.3	-31.0	-31.4	-31.3	-30.9	-30.5	-30.1	-29.7	-29.5	-29.3	-29.2	-29.1
40.0	-27.0	-27.2	-27.6	-28.2	-29.0	-29.9	-30.8	-31.7	-32.4	-32.8	-32.7	-32.3	-31.8	-31.4	-31.1	-30.8	-30.6	-30.5	-30.4
42.0	-28.4	-28.5	-28.9	-29.5	-30.3	-31.2	-32.1	-33.0	-33.7	-34.1	-34.0	-33.6	-33.2	-32.7	-32.4	-32.1	-31.9	-31.8	-31.7
44.0	-29.7	-29.8	-30.2	-30.8	-31.6	-32.4	-33.4	-34.3	-35.0	-35.4	-35.3	-34.9	-34.5	-34.0	-33.6	-33.4	-33.2	-33.0	-33.0
46.0	-30.9	-31.1	-31.4	-32.0	-32.8	-33.7	-34.6	-35.6	-36.3	-36.7	-36.6	-36.2	-35.7	-35.3	-34.9	-34.6	-34.4	-34.3	-34.2
48.0	-32.2	-32.3	-32.7	-33.3	-34.0	-34.9	-35.9	-36.9	-37.5	-37.9	-37.8	-37.5	-37.0	-36.5	-36.1	-35.8	-35.6	-35.5	-35.4
50.0	-33.4	-33.5	-33.9	-34.5	-35.2	-36.1	-37.1	-38.0	-38.8	-39.1	-39.1	-38.7	-38.2	-37.8	-37.4	-37.1	-36.8	-36.7	-36.7
52.0	-34.6	-34.8	-35.1	-35.7	-36.4	-37.3	-38.3	-39.2	-40.0	-40.4	-40.3	-40.0	-39.5	-39.0	-38.6	-38.3	-38.1	-37.9	-37.9
54.0	-35.9	-36.0	-36.3	-36.9	-37.6	-38.5	-39.5	-40.4	-41.2	-41.6	-41.6	-41.2	-40.7	-40.2	-39.8	-39.5	-39.3	-39.2	-39.1
56.0	-37.1	-37.2	-37.5	-38.1	-38.8	-39.7	-40.7	-41.7	-42.4	-42.8	-42.8	-42.4	-42.0	-41.5	-41.1	-40.7	-40.5	-40.4	-40.3
58.0	-38.3	-38.4	-38.8	-39.3	-40.1	-40.9	-41.9	-42.9	-43.7	-44.1	-44.0	-43.7	-43.2	-42.7	-42.3	-42.0	-41.8	-41.6	-41.6
60.0	-39.5	-39.7	-40.0	-40.5	-41.3	-42.2	-43.2	-44.1	-44.9	-45.3	-45.3	-45.0	-44.5	-44.0	-43.6	-43.3	-43.1	-42.9	-42.9
62.0	-40.8	-40.9	-41.3	-41.8	-42.5	-43.4	-44.4	-45.4	-46.2	-46.6	-46.6	-46.3	-45.8	-45.3	-44.9	-44.6	-44.4	-44.2	-44.2
64.0	-42.1	-42.2	-42.5	-43.1	-43.8	-44.7	-45.7	-46.7	-47.5	-47.9	-47.9	-47.6	-47.1	-46.7	-46.2	-45.9	-45.7	-45.5	-45.5
66.0	-43.4	-43.5	-43.9	-44.4	-45.1	-46.0	-47.0	-48.0	-48.8	-49.3	-49.3	-49.0	-48.5	-48.0	-47.6	-47.3	-47.1	-47.0	-46.9
68.0	-44.8	-44.9	-45.3	-45.6	-46.5	-47.4	-48.4	-49.4	-50.2	-50.7	-50.7	-50.4	-50.0	-49.5	-49.1	-48.8	-48.6	-48.4	-48.4
70.0	-46.3	-46.4	-46.7	-47.2	-48.0	-48.8	-49.8	-50.8	-51.7	-52.2	-52.2	-51.9	-51.5	-51.0	-50.6	-50.3	-50.1	-50.0	-49.9

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 20.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
2.0	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.4	11.4	11.4	11.4	11.4	11.5	11.5	11.5	11.5	11.5	11.5	11.5
4.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	10.9	10.9	10.9	10.9	10.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0
6.0	10.2	10.2	10.2	10.2	10.2	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2
8.0	9.1	9.1	9.1	9.0	9.0	9.0	8.9	8.9	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.1	9.1
10.0	7.6	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.5	7.5	7.6	7.6	7.6
12.0	5.8	5.8	5.8	5.7	5.6	5.5	5.5	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.8
14.0	3.7	3.7	3.6	3.5	3.4	3.3	3.2	3.1	3.0	3.3	3.0	3.1	3.2	3.3	3.4	3.5	3.5	3.6	3.6
16.0	1.2	1.2	1.1	.9	.8	.6	.5	.4	.3	.2	.3	.3	.5	.6	.7	.9	1.0	1.0	1.1
18.0	-1.6	-1.7	-1.8	-2.0	-2.2	-2.4	-2.6	-2.8	-2.9	-2.9	-2.9	-2.8	-2.7	-2.5	-2.3	-2.2	-2.0	-1.9	-1.9
20.0	-4.7	-4.7	-4.9	-5.2	-5.5	-5.8	-6.1	-6.3	-6.5	-6.5	-6.5	-6.3	-6.2	-6.0	-5.7	-5.5	-5.4	-5.2	-5.2
22.0	-7.7	-7.8	-8.1	-8.5	-9.0	-9.4	-9.8	-10.1	-10.3	-10.4	-10.3	-10.1	-9.9	-9.7	-9.4	-9.2	-9.0	-8.8	-8.8
24.0	-10.4	-10.5	-11.0	-11.6	-12.2	-12.8	-13.3	-13.7	-14.0	-14.2	-14.1	-13.9	-13.6	-13.3	-13.1	-12.8	-12.6	-12.4	-12.3
26.0	-12.5	-12.7	-13.2	-13.9	-14.7	-15.5	-16.1	-16.7	-17.2	-17.4	-17.3	-17.0	-16.7	-16.4	-16.2	-16.0	-15.7	-15.5	-15.4
28.0	-14.1	-14.3	-14.9	-15.7	-16.5	-17.4	-18.1	-18.8	-19.4	-19.7	-19.6	-19.2	-18.9	-18.6	-18.5	-18.3	-18.0	-17.8	-17.7
30.0	-15.6	-15.7	-16.3	-17.1	-18.0	-18.9	-19.7	-20.5	-21.1	-21.4	-21.3	-20.9	-20.6	-20.3	-20.1	-19.9	-19.7	-19.5	-19.4
32.0	-17.1	-17.3	-17.8	-18.6	-19.5	-20.4	-21.2	-22.0	-22.7	-23.0	-22.9	-22.5	-22.1	-21.9	-21.7	-21.5	-21.3	-21.1	-21.0
34.0	-18.8	-18.9	-19.4	-20.2	-21.0	-21.9	-22.8	-23.6	-24.3	-24.6	-24.5	-24.2	-23.8	-23.4	-23.2	-23.0	-22.8	-22.6	-22.6
36.0	-20.3	-20.5	-20.9	-21.6	-22.5	-23.4	-24.3	-25.1	-25.8	-26.2	-26.1	-25.7	-25.3	-24.9	-24.7	-24.4	-24.2	-24.1	-24.0
38.0	-21.8	-21.9	-22.4	-23.1	-23.9	-24.8	-25.7	-26.6	-27.3	-27.6	-27.5	-27.1	-26.7	-26.3	-26.0	-25.8	-25.6	-25.5	-25.4
40.0	-23.2	-23.3	-23.8	-24.4	-25.2	-26.1	-27.1	-27.9	-28.6	-29.0	-28.9	-28.5	-28.1	-27.7	-27.4	-27.1	-26.9	-26.8	-26.8
42.0	-24.5	-24.7	-25.1	-25.7	-26.5	-27.4	-28.4	-29.3	-30.0	-30.3	-30.3	-29.9	-29.4	-29.0	-28.7	-28.4	-28.2	-28.1	-28.0
44.0	-25.9	-26.0	-26.4	-27.0	-27.8	-28.7	-29.6	-30.6	-31.3	-31.6	-31.6	-31.2	-30.7	-30.3	-29.9	-29.7	-29.5	-29.4	-29.3
46.0	-27.1	-27.3	-27.7	-28.3	-29.0	-29.9	-30.9	-31.8	-32.5	-32.9	-32.8	-32.5	-32.0	-31.6	-31.2	-30.9	-30.7	-30.6	-30.5
48.0	-28.4	-28.5	-28.9	-29.5	-30.3	-31.2	-32.1	-33.1	-33.8	-34.2	-34.1	-33.7	-33.3	-32.8	-32.4	-32.2	-31.9	-31.8	-31.8
50.0	-29.6	-29.8	-30.1	-30.7	-31.5	-32.4	-33.3	-34.3	-35.0	-35.4	-35.3	-35.0	-34.5	-34.0	-33.7	-33.4	-33.2	-33.0	-33.0
52.0	-30.9	-31.0	-31.3	-31.9	-32.7	-33.6	-34.5	-35.5	-36.2	-36.6	-36.6	-36.2	-35.7	-35.3	-34.9	-34.6	-34.4	-34.3	-34.2
54.0	-32.1	-32.2	-32.5	-33.1	-33.9	-34.8	-35.7	-36.7	-37.4	-37.8	-37.8	-37.5	-37.0	-36.5	-36.1	-35.8	-35.6	-35.5	-35.4
56.0	-33.3	-33.4	-33.8	-34.3	-35.1	-36.0	-36.9	-37.9	-38.7	-39.1	-39.0	-38.7	-38.2	-37.7	-37.3	-37.0	-36.8	-36.7	-36.7
58.0	-34.5	-34.6	-35.0	-35.5	-36.3	-37.2	-38.2	-39.1	-39.9	-40.3	-40.3	-40.0	-39.5	-39.0	-38.6	-38.3	-38.1	-38.0	-37.9
60.0	-35.7	-35.9	-36.2	-36.8	-37.5	-38.4	-39.4	-40.3	-41.1	-41.6	-41.6	-41.2	-40.7	-40.3	-39.9	-39.6	-39.3	-39.2	-39.2
62.0	-37.0	-37.1	-37.5	-38.0	-38.7	-39.6	-40.6	-41.6	-42.4	-42.8	-42.8	-42.5	-42.0	-41.6	-41.2	-40.9	-40.6	-40.5	-40.5
64.0	-38.3	-38.4	-38.7	-39.3	-40.0	-40.9	-41.9	-42.9	-43.7	-44.1	-44.2	-43.8	-43.4	-42.9	-42.5	-42.2	-42.0	-41.9	-41.8
66.0	-39.6	-39.7	-40.0	-40.6	-41.3	-42.2	-43.2	-44.2	-45.0	-45.5	-45.5	-45.2	-44.7	-44.3	-43.9	-43.6	-43.4	-43.2	-43.2
68.0	-41.0	-41.1	-41.4	-42.0	-42.7	-43.6	-44.6	-45.6	-46.4	-46.9	-46.9	-46.6	-46.2	-45.7	-45.3	-45.0	-44.8	-44.7	-44.6
70.0	-42.4	-42.5	-42.8	-43.4	-44.1	-45.0	-46.0	-47.0	-47.8	-48.3	-48.4	-48.1	-47.6	-47.2	-46.8	-46.5	-46.3	-46.1	-46.1

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 25.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
2.0	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
4.0	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.5	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
6.0	9.9	9.9	9.9	9.9	9.9	9.9	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.9	9.9	9.9	9.9	9.9	9.9
8.0	8.9	8.9	8.9	8.9	8.8	8.8	8.8	8.8	8.7	8.7	8.7	8.8	8.8	8.8	8.8	6.9	8.9	8.9	8.9
10.0	7.6	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.5	7.5	7.6	7.6	7.6
12.0	6.0	6.0	5.9	5.9	5.8	5.7	5.7	5.6	5.6	5.6	5.6	5.6	5.7	5.7	5.8	5.9	5.9	5.9	6.0
14.0	4.1	4.1	4.0	3.9	3.8	3.7	3.6	3.5	3.5	3.4	3.5	3.5	3.6	3.7	3.8	3.9	3.9	4.0	4.0
16.0	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.0	1.0	.9	1.0	1.0	1.1	1.3	1.4	1.5	1.6	1.7	1.7
18.0	-.6	-.7	-.8	-1.0	-1.2	-1.4	-1.6	-1.9	-1.9	-1.9	-1.9	-1.8	-1.7	-1.5	-1.4	-1.2	-1.1	-1.0	-.9
20.0	-3.3	-3.4	-3.6	-3.9	-4.2	-4.5	-4.7	-4.9	-5.1	-5.1	-5.1	-5.0	-4.8	-4.6	-4.4	-4.2	-4.1	-3.9	-3.9
22.0	-5.9	-6.0	-6.3	-6.8	-7.2	-7.6	-8.0	-8.3	-5.9	-8.6	-8.5	-8.3	-3.1	-7.9	-7.7	-7.5	-7.3	-7.1	-7.1
24.0	-8.2	-8.4	[illegible]	-9.4	-10.0	-10.6	-11.1	-11.5	-11.8	-12.0	-11.9	-11.7	-11.4	-11.2	-11.0	-10.7	-10.5	-10.3	-10.2
26.0	-10.1	-10.3	-10.8	-11.5	-12.3	-13.0	-13.7	-14.2	-14.7	-14.9	-14.8	-14.5	-14.2	-14.0	-13.8	-13.6	-13.3	-13.1	-13.0
28.0	-11.5	-11.7	-12.3	-13.1	-14.0	-14.8	-15.5	-16.2	-16.8	-17.1	-16.9	-16.6	-16.3	-16.1	-15.9	-15.7	-15.4	-15.2	-15.1
30.0	-12.9	-13.0	-13.6	-14.4	-15.3	-16.2	-17.0	-17.7	-18.3	-18.6	-18.5	-18.2	-17.8	-17.6	-17.4	-17.3	-17.0	-16.8	-16.7
32.0	-14.2	-14.4	-14.9	-15.7	-16.6	-17.5	-18.3	-19.1	-19.8	-20.1	-20.0	-19.6	-19.3	-19.0	-18.8	-18.6	-18.4	-18.2	-18.1
34.0	-15.8	[illegible]	-16.5	-17.2	-18.1	-19.0	-19.9	-20.7	-21.3	-21.7	-21.6	-21.2	-20.8	-20.5	-20.3	-20.1	-19.9	-19.7	-19.7
36.0	-17.3	-17.5	-18.0	-18.7	-19.6	-20.5	-21.4	-22.2	-22.9	-23.2	-23.1	-22.7	-22.3	-22.0	-21.8	-21.6	-21.4	-21.2	-21.1
38.0	-18.8	-19.0	-19.4	-20.1	-21.0	-21.9	-22.8	-23.6	-24.3	-24.7	-24.6	-24.2	-23.8	-23.4	-23.2	-22.9	-22.7	-22.6	-22.5
40.0	-20.2	-20.4	-20.8	-21.5	-22.3	-23.2	-24.1	-25.0	-25.7	-26.1	-26.0	-25.6	-25.2	-24.8	-24.5	-24.3	-24.1	-23.9	-23.9
42.0	-21.6	-21.7	-22.2	-22.8	-23.6	-24.5	-25.5	-26.3	-27.1	-27.4	-27.3	-27.0	-26.5	-26.1	-25.8	-25.6	-25.4	-25.2	-25.2
44.0	-22.9	-23.1	-23.5	-24.1	-24.9	-25.8	-26.7	-27.6	-28.4	-28.7	-28.7	-28.3	-27.8	-27.4	-27.1	-26.8	-26.6	-26.5	-26.5
46.0	-24.2	-24.3	-24.7	-25.3	-26.1	-27.0	-28.0	-28.9	-29.6	-30.0	-29.9	-29.6	-29.1	-28.7	-28.3	-28.1	-27.9	-27.7	-27.7
48.0	-25.5	-25.6	-26.0	-26.6	-27.4	-28.3	-29.2	-30.1	-30.9	-31.2	-31.2	-30.8	-30.4	-29.9	-29.6	-29.3	-29.1	-29.0	-28.9
50.0	-26.7	-26.8	-27.2	-27.8	-28.6	-29.5	-30.4	-31.4	-32.1	-32.5	-32.4	-32.1	-31.6	-31.2	-30.8	-30.5	-30.3	-30.2	-30.1
52.0	-27.9	-28.0	-28.4	-29.0	-29.8	-30.7	-31.6	-32.6	-33.3	-33.7	-33.7	-33.3	-32.8	-32.4	-32.0	-31.7	-31.5	-31.4	-31.4
54.0	-29.1	-29.3	-29.6	-30.2	-31.0	-31.9	-32.8	-33.8	-34.5	-34.9	-34.9	-34.6	-34.1	-33.6	-33.2	-32.9	-32.7	-32.6	-32.6
56.0	-30.3	-30.5	-30.8	-31.4	-32.1	-33.0	-34.0	-35.0	-35.7	-36.2	-36.1	-35.8	-35.3	-34.9	-34.5	-34.2	-34.0	-33.8	-33.8
58.0	-31.6	-31.7	-32.0	-32.6	-33.4	-34.3	-35.2	-36.2	-37.0	-37.4	-37.4	-37.0	-36.6	-36.1	-35.7	-35.4	-35.2	-35.1	-35.0
60.0	-32.8	-32.9	-33.3	-33.8	-34.6	-35.5	-36.5	-37.4	-38.2	-38.6	-38.6	-38.3	-37.8	-37.4	-37.0	-36.7	-36.5	-36.3	-36.3
62.0	-34.0	-34.2	-34.5	-35.1	-35.8	-36.7	-37.7	-38.7	-39.5	-39.9	-39.9	-39.6	-39.1	-38.7	-38.3	-38.0	-37.8	-37.6	-37.6
64.0	-35.3	-35.4	-35.8	-36.3	-37.1	-38.0	-39.0	-39.9	-40.7	-41.2	-41.2	-40.9	-40.4	-40.0	-39.6	-39.3	-39.1	-38.9	-38.9
66.0	-36.6	-36.7	-37.1	-37.6	-38.4	-39.3	-40.3	-41.3	-42.1	-42.5	-42.6	-42.3	-41.8	-41.3	-40.9	-40.6	-40.4	-40.3	-40.3
68.0	-38.0	-38.1	-38.4	-39.0	-39.7	-40.6	-41.6	-42.6	-43.4	-43.9	-44.0	-43.7	-43.2	-42.7	-42.3	-42.0	-41.8	-41.7	-41.7
70.0	-39.4	-39.5	-39.8	-40.4	-41.1	-42.0	-43.0	-44.0	-44.9	-45.3	-45.4	-45.1	-44.7	-44.2	-43.8	-43.5	-43.3	-43.2	-43.1

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 30.0 CM/SEC

INCIDENCE ANGLE (DEG	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
2.0	10.8	10.8	10.8	10.8	10.8	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.8	10.8	10.8	10.8	10.8
4.0	10.4	10.4	10.4	10.4	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.4	10.4	10.4	10.4
6.0	9.7	9.7	9.7	9.7	9.7	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.7	9.7	9.7	9.7	9.7
8.0	8.6	8.6	8.6	8.7	8.7	8.7	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.7	8.7	8.7	8.7	8.8	8.8
10.0	7.6	7.6	7.5	7.5	7.5	7.4	7.4	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.4	7.5	7.5	7.5	7.6
12.0	6.1	6.1	6.1	6.0	5.9	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.8	5.8	5.9	6.0	6.0	6.0	6.1
14.0	4.4	4.3	4.3	4.2	4.1	4.0	3.9	3.8	3.7	3.7	3.7	3.8	3.9	3.9	4.0	4.1	4.2	4.2	4.2
16.0	2.4	2.3	2.2	2.1	1.9	1.8	1.6	1.5	1.5	1.4	1.5	1.5	1.6	1.7	1.8	2.0	2.0	2.1	2.1
18.0	.1	.1	-.1	-.3	-.5	-.7	-.9	-1.0	-1.2	-1.2	-1.2	-1.1	-.9	-.8	-.7	-.5	-.4	-.3	-.3
20.0	-2.2	-2.3	-2.6	-2.9	-3.2	-3.5	-3.7	-3.9	-4.1	-4.1	-4.1	-4.0	-3.8	-3.6	-3.5	-3.3	-3.1	-3.0	-3.0
22.0	-4.5	-4.7	-5.0	-5.4	-5.9	-6.3	-6.6	-6.9	-7.1	-7.2	-7.2	-7.0	-6.8	-6.6	-6.4	-6.2	-6.0	-5.9	-5.8
24.0	-6.6	-6.7	-7.2	-7.8	-8.4	-9.0	-9.4	-9.9	-10.2	-10.3	-10.2	-10.0	-9.8	-9.6	-9.4	-9.1	-8.9	-8.7	-8.7
26.0	-8.2	-8.4	-8.9	-9.7	-10.5	-11.2	-11.8	-12.3	-12.8	-13.0	-12.9	-12.6	-12.3	-12.1	-11.9	-11.7	-11.5	-11.2	-11.2
28.0	-9.5	-9.7	-10.3	-11.1	-12.0	-12.8	-13.5	-14.2	-14.7	-15.0	-14.9	-14.6	-14.2	-14.0	-13.9	-13.7	-13.4	-13.2	-13.1
30.0	-10.7	-10.9	-11.5	-12.3	-13.2	-14.1	-14.8	-15.6	-16.2	-16.5	-16.4	-16.0	-15.7	-15.5	-15.3	-15.1	-14.9	-14.7	-14.6
32.0	-11.9	-12.1	-12.7	-13.5	-14.4	-15.3	-16.1	-16.9	-17.5	-17.8	-17.7	-17.3	-17.0	-16.8	-16.6	-16.4	-16.2	-16.0	-15.9
34.0	-13.3	-13.5	-14.0	-14.8	-15.7	-16.6	-17.5	-18.3	-18.9	-19.2	-19.1	-18.8	-18.4	-18.1	-17.9	-17.8	-17.5	-17.4	-17.3
36.0	-14.9	-15.1	-15.6	-16.3	-17.2	-18.1	-19.0	-19.8	-20.5	-20.8	-20.7	-20.3	-19.9	-19.6	-19.4	-19.2	-19.0	-18.9	-18.8
38.0	-16.4	-16.6	-17.0	-17.7	-18.6	-19.5	-20.4	-21.2	-21.9	-22.3	-22.2	-21.8	-21.4	-21.1	-20.8	-20.6	-20.4	-20.2	-20.2
40.0	-17.	-18.0	-18.4	-19.1	-19.9	-20.8	-21.8	-22.6	-23.3	-23.7	-23.6	-23.2	-22.8	-22.4	-22.1	-21.9	-21.7	-21.6	-21.5
42.0	-19.2	-19.3	-19.8	-20.4	-21.2	-22.1	-23.1	-24.0	-24.7	-25.0	-24.9	-24.6	-24.1	-23.8	-23.5	-23.2	-23.0	-22.9	-22.8
44.0	-20.5	-20.6	-21.1	-21.7	-22.5	-23.4	-24.4	-25.3	-26.0	-26.3	-26.3	-25.9	-25.5	-25.0	-24.7	-24.5	-24.3	-24.2	-24.1
46.0	-21.8	-21.9	-22.3	-23.0	-23.8	-24.7	-25.6	26.5	-27.2	-27.6	-27.6	-27.2	-26.7	-26.3	-26.0	-25.7	-25.5	-25.4	-25.4
48.0	-23.0	-23.2	-23.6	-24.2	-25.0	-25.9	-26.6	-27.8	-28.5	-28.9	-28.8	-28.5	-28.0	-27.6	-27.2	-27.0	-26.8	-26.6	-26.6
50.0	-24.3	-24.4	-24.8	-25.4	-26.2	-27.1	-28.0	-29.0	-29.7	-30.1	-30.1	-29.7	-29.2	-28.8	-28.4	-28.2	-28.0	-27.8	-27.8
52.0	-25.5	-25.6	-26.0	-26.6	-27.4	-28.3	-29.2	-30.2	-30.9	-31.3	-31.3	-30.9	-30.5	-30.0	-29.7	-29.4	-29.2	-29.1	-29.0
54.0	-26.7	-26.8	-27.2	-27.8	-28.6	-29.5	-30.4	-31.4	-32.2	-32.6	-32.5	-32.2	-31.7	-31.3	-30.9	-30.6	-30.4	-30.3	-30.2
56.0	-27.9	-28.1	-28.4	-29.0	-29.8	-30.7	-31.6	-32.6	-33.4	-33.8	-33.8	-33.4	-32.9	-32.5	-32.1	-31.8	-31.6	-31.5	-31.5
58.0	-29.2	-29.3	-29.6	-30.2	-31.0	-31.9	-32.8	-33.8	-34.6	-35.0	-35.0	-34.7	-34.2	-33.7	-33.3	-33.1	-32.9	-32.7	-32.7
60.0	-30.4	-30.5	-30.9	-31.4	-32.2	-33.1	-34.1	-35.0	-35.8	-36.2	-36.2	-35.9	-35.5	-35.0	-34.6	-34.3	-34.1	-34.0	-33.9
62.0	-31.6	-31.7	-32.1	-32.7	-33.4	-34.3	-35.3	-36.3	-37.1	-37.5	-37.5	-37.2	-36.7	-36.3	-35.9	-35.6	-35.4	-35.3	-35.2
64.0	-32.9	-33.0	-33.4	-33.9	-34.7	-35.6	-36.6	-37.5	-38.3	-38.8	-38.8	-38.5	-38.0	-37.6	-37.2	-36.9	-36.7	-36.6	-36.5
66.0	-34.2	-34.3	-34.7	-35.2	-36.0	-36.9	-37.8	-38.8	-39.7	-40.1	-40.2	-39.8	-39.4	-38.9	-38.5	-38.2	-38.0	-37.9	-37.9
68.0	-35.6	-35.7	-36.0	-36.5	-37.3	-38.2	-39.2	-40.2	-41.0	-41.5	-41.5	-41.2	-40.8	-40.3	-39.9	-39.6	-39.4	-39.3	-39.3
70.0	-37.0	-37.1	-37.4	-37.9	-38.7	-39.6	-40.6	-41.6	-42.4	-42.9	-43.0	-42.7	-42.2	-41.8	-41.4	-41.1	-40.9	-40.8	-40.7

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 35.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
2.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
4.0	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
6.0	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.4	9.4	9.4	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5	9.5
8.0	8.7	8.7	8.6	8.6	8.6	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.6	8.6	8.6	8.6	8.6	8.6
10.0	7.6	7.5	7.5	7.5	7.4	7.4	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.4	7.5	7.5	7.5
12.0	6.2	6.2	6.1	6.1	6.0	5.9	5.8	5.8	5.8	5.7	5.8	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.1
14.0	4.6	4.5	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.9	3.9	4.0	4.1	4.1	4.2	4.3	4.4	4.4	4.4
16.0	2.7	2.7	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.4	2.5
18.0	.7	.6	.5	.3	.0	-.2	-.4	-.5	-.6	-.6	-.6	-.5	-.4	-.3	-.1	-.0	.1	.2	.2
20.0	-1.4	-1.5	-1.7	-2.1	-2.4	-2.7	-2.9	-3.1	-3.3	-3.3	-3.3	-3.2	-3.0	-2.9	-2.7	-2.6	-2.4	-2.3	-2.2
22.0	-3.4	-3.6	-3.9	-4.4	-4.9	-5.3	-5.6	-5.9	-6.1	-6.2	-6.2	-6.0	-5.8	-5.6	-5.4	-5.3	-5.1	-4.9	-4.9
24.0	-5.2	-5.4	-5.9	-6.5	-7.1	-7.7	-8.1	-8.6	-8.9	-9.0	-8.9	-8.7	-8.5	-8.3	-8.1	-7.9	-7.7	-7.5	-7.4
26.0	-6.7	-6.9	-7.4	-8.2	-9.0	-9.7	-10.3	-10.8	-11.2	-11.5	-11.4	-11.1	-10.6	-10.6	-10.4	-10.2	-10.0	-9.8	-9.7
28.0	-7.8	-8.0	-8.6	-9.5	-10.3	-11.1	-11.9	-12.5	-13.0	-13.3	-13.2	-12.9	-12.6	-12.4	-12.2	-12.0	-11.8	-11.6	-11.5
30.0	-8.9	-9.1	-9.7	-10.5	-11.5	-12.3	-13.1	-13.8	-14.4	-14.7	-14.6	-14.2	-13.9	-13.7	-13.6	-13.4	-13.2	-12.9	-12.8
32.0	-10.0	-10.2	-10.6	-11.6	-12.5	-13.4	-14.2	-15.0	-15.6	-15.9	-15.8	-15.5	-15.1	-14.9	-14.8	-14.6	-14.4	-14.1	-14.0
34.0	-11.3	-11.5	-12.1	-12.9	-13.6	-14.6	-15.5	-16.3	-16.9	-17.2	-17.1	-16.8	-16.4	-16.2	-16.0	-15.8	-15.6	-15.4	-15.3
36.0	-12.8	-13.0	-13.5	-14.3	-15.2	-16.1	-16.9	-17.7	-18.4	-18.7	-18.6	-18.3	-17.9	-17.6	-17.4	-17.2	-17.0	-16.8	-16.8
38.0	-14.3	-14.5	-15.0	-15.7	-16.6	-17.5	-18.4	-19.2	-19.9	-20.2	-20.1	-19.8	-19.4	-19.0	-18.8	-18.6	-18.4	-18.2	-18.2
40.0	-15.3	-15.9	-16.4	-17.1	-17.9	-18.8	-19.7	-20.6	-21.3	-21.6	-21.6	-21.2	-20.8	-20.4	-20.2	-19.9	-19.7	-19.6	-19.5
42.0	-17.1	-17.3	-17.7	-18.4	-19.2	-20.1	-21.1	-21.9	-22.6	-23.0	-22.9	-22.6	-22.1	-21.8	-21.5	-21.2	-21.0	-20.9	-20.9
44.0	-18.5	-18.6	-19.0	-19.7	-20.5	-21.4	-22.3	-23.2	-24.0	-24.3	-24.2	-23.9	-23.4	-23.1	-22.7	-22.5	-22.3	-22.2	-22.1
46.0	-19.8	-19.9	-20.3	-20.9	-21.7	-22.6	-23.6	-24.5	-25.2	-25.6	-25.5	-25.2	-24.7	-24.3	-24.0	-23.7	-23.6	-23.4	-23.4
48.0	-21.0	-21.2	-21.6	-22.2	-23.0	-23.9	-24.8	-25.7	-26.5	-26.9	-26.8	-26.4	-26.0	-25.6	-25.2	-25.0	-24.8	-24.7	-24.6
50.0	-22.3	-22.4	-22.8	-23.4	-24.2	-25.1	-26.0	-27.0	-27.7	-28.1	-28.0	-27.7	-27.2	-26.8	-26.5	-26.2	-26.0	-25.9	-25.8
52.0	-23.5	-23.6	-24.0	-24.6	-25.4	-26.3	-27.2	-28.2	-28.9	-29.3	-29.3	-28.9	-28.5	-28.0	-27.7	-27.4	-27.2	-27.1	-27.0
54.0	-24.7	-24.8	-25.2	-25.8	-26.6	-27.5	-28.4	-29.4	-30.1	-30.5	-30.5	-30.2	-29.7	-29.3	-28.9	-28.6	-28.4	-28.3	-28.2
56.0	-25.9	-26.0	-26.4	-27.0	-27.7	-28.6	-29.6	-30.6	-31.3	-31.8	-31.7	-31.4	-30.9	-30.5	-30.1	-29.8	-29.6	-29.5	-29.5
58.0	-27.1	-27.2	-27.6	-28.2	-28.9	-29.8	-30.8	-31.8	-32.6	-33.0	-33.0	-32.6	-32.2	-31.7	-31.3	-31.1	-30.9	-30.7	-30.7
60.0	-28.3	-28.5	-28.6	-29.4	-30.1	-31.0	-32.0	-33.0	-33.8	-34.2	-34.2	-33.9	-33.4	-33.0	-32.6	-32.3	-32.1	-32.0	-31.9
62.0	-29.6	-29.7	-30.1	-30.6	-31.4	-32.3	-33.3	-34.2	-35.0	-35.5	-35.5	-35.2	-34.7	-34.3	-33.9	-33.6	-33.4	-33.3	-33.2
64.0	-30.9	-31.0	-31.3	-31.9	-32.6	-33.5	-34.5	-35.5	-36.3	-36.8	-36.8	-36.5	-36.0	-35.6	-35.2	-34.9	-34.7	-34.6	-34.5
66.0	-32.2	-32.3	-32.6	-33.2	-33.9	-34.8	-35.8	-36.8	-37.6	-38.1	-38.1	-37.8	-37.4	-36.9	-36.5	-36.2	-36.0	-35.9	-35.9
68.0	-33.5	-33.6	-33.9	-34.5	-35.2	-36.1	-37.1	-38.1	-39.0	-39.4	-39.5	-39.2	-38.7	-38.3	-37.9	-37.6	-37.4	-37.3	-37.2
70.0	-34.9	-35.0	-35.3	-35.9	-36.6	-37.5	-38.5	-39.5	-40.4	-40.9	-40.9	-40.6	-40.2	-39.7	-39.3	-39.0	-38.8	-38.7	-38.7

ORIGINAL PAGE IS
OF POOR QUALITY

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 40.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
2.0	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
4.0	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
6.0	9.4	9.4	9.4	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.4	9.4
8.0	8.6	8.6	8.5	8.5	8.5	8.5	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.5	8.5	8.5	8.5	8.5
10.0	7.5	7.5	7.5	7.4	7.4	7.3	7.3	7.3	7.2	7.2	7.2	7.3	7.3	7.3	7.4	7.4	7.4	7.5	7.5
12.0	6.3	6.2	6.2	6.1	6.0	6.0	5.9	5.8	5.8	5.8	5.8	5.8	5.9	5.9	6.0	6.1	6.1	6.1	6.1
14.0	4.7	4.7	4.6	4.5	4.4	4.3	4.2	4.2	4.1	4.1	4.1	4.1	4.2	4.3	4.4	4.4	4.5	4.5	4.6
16.0	3.0	3.0	2.9	2.7	2.6	2.4	2.3	2.2	2.1	2.1	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.7	2.7
18.0	1.2	1.1	.9	.7	.5	.3	.1	-.1	-.2	-.2	-.2	-.1	.0	.2	.3	.4	.5	.6	.6
20.0	-.7	-.8	-1.1	-1.4	-1.8	-2.1	-2.3	-2.5	-2.7	-2.7	-2.7	-2.6	-2.4	-2.3	-2.1	-2.0	-1.8	-1.7	-1.7
22.0	-2.5	-2.7	-3.0	-3.5	-4.0	-4.4	-4.8	-5.1	-5.3	-5.4	-5.3	-5.2	-5.0	-4.8	-4.6	-4.5	-4.3	-4.1	-4.1
24.0	-4.1	-4.3	-4.7	-5.4	-6.0	-6.5	-7.1	-7.5	-7.8	-8.0	-7.9	-7.7	-7.4	-7.2	-7.1	-6.9	-6.7	-6.5	-6.4
26.0	-5.4	-5.6	-6.1	-6.9	-7.7	-8.4	-9.0	-9.5	-10.0	-10.2	-10.1	-9.8	-9.5	-9.4	-9.2	-9.0	-8.8	-8.5	-8.5
28.0	-6.4	-6.6	-7.2	-8.1	-9.0	-9.8	-10.4	-11.1	-11.6	-11.9	[illegible]	-11.5	-11.2	-11.0	-10.8	-10.7	-10.4	-10.2	-10.1
30.0	-7.4	-7.6	-8.2	-9.1	-10.0	-10.8	-11.6	-12.3	-12.9	-13.2	-13.1	-12.7	-12.4	-12.2	-12.1	-11.9	-11.7	-11.4	-11.3
32.0	-8.4	-8.6	-9.2	-10.1	-11.0	-11.9	-12.6	-13.4	-14.0	-14.3	-14.2	-13.9	-13.5	-13.3	-13.2	-13.0	-12.8	-12.6	-12.5
34.0	-9.6	-9.8	-10.4	-11.2	-12.1	-13.0	-13.8	-14.6	-15.2	-15.6	-15.5	-15.1	-14.7	-14.5	-14.3	-14.2	-14.0	-13.7	-13.7
36.0	-11.0	-11.2	-11.8	-12.5	-13.4	-14.3	-15.2	-16.0	-16.6	-17.0	-16.9	-16.5	-16.1	-15.9	-15.7	-15.5	-15.3	-15.1	-15.0
38.0	-12.5	-12.7	-13.2	-14.0	-14.8	-15.7	-16.6	-17.4	-18.1	-18.5	-18.4	-18.0	-17.6	-17.3	-17.1	-16.9	-16.7	-16.5	-16.4
40.0	-14.0	-14.1	-14.6	-15.3	-16.2	-17.1	-18.0	-18.8	-19.5	-19.9	-19.8	-19.4	-19.0	-18.7	-18.4	-16.2	-18.0	-17.9	-17.8
42.0	-15.4	-15.5	-16.0	-16.7	-17.5	-18.4	-19.3	-20.2	-20.9	-21.2	-21.2	-20.8	-20.4	-20.0	-19.7	-19.5	-19.3	-19.2	-19.1
44.0	-16.7	-16.8	-17.3	-17.9	-18.6	-19.7	-20.6	-21.5	-22.2	-22.6	-22.5	-22.1	-21.7	-21.3	-21.0	-20.8	-20.6	-20.5	-20.4
46.0	-18.0	-18.1	-18.5	-19.2	-20.0	-20.9	-21.9	-22.8	-23.5	-23.8	-23.8	-23.4	-23.0	-22.6	-22.3	-22.0	-21.8	-21.7	-21.7
48.0	-19.2	-19.4	-19.8	-20.4	-21.2	-22.1	-23.1	-24.0	-24.7	-25.1	-25.1	-24.7	-24.2	-23.8	-23.5	-23.3	-23.1	-22.9	-22.9
50.0	-20.5	-20.6	-21.0	-21.6	-22.4	-23.3	-24.3	-25.2	-26.0	-26.3	-26.3	-26.0	-25.5	-25.1	-24.7	-24.5	-24.3	-24.1	-24.1
52.0	-21.7	-21.8	-22.2	-22.8	-23.6	-24.5	-25.5	-26.4	-27.2	-27.6	-27.5	-27.2	-26.7	-26.3	-25.9	-25.7	-25.5	-25.4	-25.3
54.0	-22.9	-23.1	-23.4	-24.0	-24.8	-25.7	-26.7	-27.6	-28.4	-28.8	-28.8	-28.4	-28.0	-27.5	-27.2	-26.9	-26.7	-26.6	-26.5
56.0	-24.1	-24.3	-24.6	-25.2	-26.0	-26.9	-27.9	-28.8	-29.6	-30.0	-30.0	-29.7	-29.2	-28.7	-28.4	-28.1	-27.9	-27.8	-27.7
58.0	-25.4	-25.5	-25.8	-26.4	-27.2	-28.1	-29.1	-30.0	-30.8	-31.2	-31.2	-30.9	-30.4	-30.0	-29.6	-29.3	-29.1	-29.0	-29.0
60.0	-26.6	-26.7	-27.1	-27.6	-28.4	-29.3	-30.3	-31.2	-32.0	-32.5	-32.5	-32.1	-31.7	-31.2	-30.9	-30.6	-30.4	-30.3	-30.2
62.0	-27.8	-27.9	-28.3	-28.9	-29.6	-30.5	-31.5	-32.5	-33.3	-33.7	-33.7	-33.4	-33.0	-32.5	-32.1	-31.8	-31.6	-31.5	-31.9
64.0	-29.1	-29.2	-29.5	-30.1	-30.9	-31.8	-32.8	-33.7	-34.5	-35.0	-35.0	-34.7	-34.1	-33.8	-33.4	-33.1	-32.7	-32.9	-32.8
66.0	-30.4	-30.5	-30.8	-31.4	-32.1	-33.0	-34.0	-35.0	-35.8	-36.3	-36.3	-36.0	-35.6	-35.1	-34.7	-34.4	-34.3	-34.1	-34.1
68.0	-31.7	-31.8	-32.2	-32.7	-33.5	-34.4	-35.4	-36.4	-37.2	-37.7	-37.7	-37.4	-37.0	-36.5	-36.1	-35.8	-35.6	[illegible]	[illegible]
70.0	-33.1	-33.2	-33.5	-34.1	-34.8	-35.7	-36.7	-37.7	-38.6	-39.1	-39.1	-38.8	-38.4	-37.9	-37.5	-37.2	-37.0	-36.9	-36.9

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 45.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
2.0	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
4.0	9.8	9.8	9.8	9.8	9.8	9.8	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.8	9.8	9.8	9.8	9.8
6.0	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.1	9.1	9.1	9.1	9.1	9.2	9.2	9.2	9.2	9.2	9.2	9.2
8.0	8.5	8.5	8.4	8.4	8.4	8.4	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.4	8.4	8.4	8.4
10.0	7.5	7.5	7.4	7.4	7.3	7.3	7.3	7.2	7.2	7.2	7.2	7.2	7.3	7.3	7.3	7.4	7.4	7.4	7.4
12.0	6.3	6.3	6.2	6.1	6.1	6.0	5.9	5.9	5.8	5.8	5.8	5.9	5.9	6.0	6.0	6.1	6.1	6.2	6.2
14.0	4.9	4.9	4.8	4.7	4.5	4.4	4.4	4.3	4.2	4.2	4.2	4.3	4.3	4.4	4.5	4.5	4.6	4.7	4.7
16.0	3.3	3.3	3.1	3.0	2.8	2.6	2.5	2.4	2.3	2.3	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	2.9
18.0	1.6	1.5	1.4	1.1	.9	.6	.5	.3	.2	.2	.2	.3	.4	.5	.6	.7	.9	.9	1.0
20.0	-.1	-.2	-.5	-.9	-1.2	-1.5	-1.8	-2.0	-2.1	-2.2	-2.2	-2.0	-1.9	-1.8	-1.6	-1.5	-1.3	-1.2	-1.2
22.0	-1.7	-1.9	-2.3	-2.6	-3.3	-3.7	-4.0	-4.3	-4.6	-4.7	-4.6	-4.4	-4.3	-4.1	-4.0	-3.8	-3.6	-3.4	-3.4
24.0	-3.1	-3.3	-3.5	-4.4	-5.1	-5.7	-6.1	-6.6	-6.9	-7.0	-7.0	-6.8	-6.5	-6.4	-6.2	-6.0	-5.8	-5.6	-5.5
26.0	-4.2	-4.4	-5.0	-5.8	-6.6	-7.3	-7.9	-8.4	-8.9	-9.1	-9.0	-8.7	-8.5	-8.3	-8.1	-8.0	-7.7	-7.5	-7.4
28.0	-5.2	-5.4	-6.0	-6.9	-7.7	-8.5	-9.2	-9.9	-10.4	-10.7	-10.6	-10.2	-9.9	-9.8	-9.7	-9.5	-9.2	-9.0	-8.9
30.0	-6.1	-6.3	-6.9	-7.8	-8.7	-9.5	-10.3	-11.0	-11.6	-11.9	-11.8	-11.4	-11.1	-10.9	-10.8	-10.7	-10.4	-10.2	-10.1
32.0	-7.0	-7.2	-7.8	-8.7	-9.6	-10.5	-11.3	-12.0	-12.6	-13.0	-12.8	-12.5	-12.2	-12.0	-11.9	-11.7	-11.4	-11.2	-11.1
34.0	-8.1	-8.3	-8.9	-9.7	-10.7	-11.5	-12.4	-13.1	-13.8	-14.1	-14.0	-13.6	-13.3	-13.1	-12.9	-12.7	-12.5	-12.3	-12.2
36.0	-9.5	-9.7	-10.2	-11.0	-11.9	-12.8	-13.6	-14.4	-15.1	-15.4	-15.3	-15.0	-14.6	-14.3	-14.2	-14.0	-13.8	-13.6	-13.5
38.0	-11.0	-11.1	-11.7	-12.4	-13.3	-14.2	-15.1	-15.9	-16.6	-16.9	-16.8	-16.5	-16.1	-15.8	-15.6	-15.4	-15.2	-15.0	-14.9
40.0	-12.4	-12.6	-13.1	-13.8	-14.6	-15.5	-16.4	-17.3	-18.0	-18.3	-18.2	-17.9	-17.5	-17.1	-16.9	-16.7	-16.5	-16.3	-16.3
42.0	-13.8	-14.0	-14.4	-15.1	-16.0	-16.9	-17.8	-18.6	-19.3	-19.7	-19.6	-19.3	-18.8	-18.5	-18.2	-18.0	-17.8	-17.7	-17.6
44.0	-15.1	-15.3	-15.7	-16.4	-17.2	-18.1	-19.1	-19.9	-20.7	-21.0	-20.9	-20.6	-20.2	-19.8	-19.5	-19.3	-19.1	-18.9	-18.9
46.0	-16.4	-16.6	-17.0	-17.7	-18.5	-19.4	-20.3	-21.2	-21.9	-22.3	-22.2	-21.9	-21.4	-21.1	-20.8	-20.5	-20.3	-20.2	-20.1
48.0	-17.7	-17.8	-18.2	-18.9	-19.7	-20.6	-21.5	-22.5	-23.2	-23.6	-23.5	-23.2	-22.7	-22.3	-22.0	-21.7	-21.5	-21.4	-21.4
50.0	-18.9	-19.1	-19.5	-20.1	-20.9	-21.8	-22.8	-23.7	-24.4	-24.8	-24.8	-24.4	-24.0	-23.5	-23.2	-23.0	-22.8	-22.6	-22.6
52.0	-20.2	-20.3	-20.7	-21.3	-22.1	-23.0	-24.0	-24.9	-25.6	-26.0	-26.0	-25.7	-25.2	-24.8	-24.4	-24.2	-24.0	-23.8	-23.8
54.0	-21.4	-21.5	-21.9	-22.5	-23.3	-24.2	-25.1	-26.1	-26.8	-27.2	-27.2	-26.9	-26.4	-26.0	-25.6	-25.4	-25.2	-25.0	-25.0
56.0	-22.6	-22.7	-23.1	-23.7	-24.5	-25.4	-26.3	-27.3	-28.1	-28.5	-28.5	-28.1	-27.7	-27.2	-26.9	-26.6	-26.4	-26.3	-26.2
58.0	-23.8	-23.9	-24.3	-24.9	-25.6	-26.5	-27.5	-28.5	-29.3	-29.7	-29.7	-29.4	-28.9	-28.4	-28.1	-27.8	-27.6	-27.5	-27.4
60.0	-25.0	-25.1	-25.5	-26.1	-26.8	-27.7	-28.7	-29.7	-30.5	-30.9	-30.9	-30.6	-30.1	-29.7	-29.3	-29.0	-28.8	-28.7	-28.7
62.0	-26.3	-26.4	-26.7	-27.3	-28.1	-29.0	-30.0	-30.9	-31.7	-32.2	-32.2	-31.9	-31.4	-31.0	-30.6	-30.3	-30.1	-30.0	-29.9
64.0	-27.5	-27.6	-28.0	-28.6	-29.3	-30.2	-31.2	-32.2	-33.0	-33.4	-33.5	-33.2	-32.7	-32.2	-31.9	-31.6	-31.4	-31.3	-31.2
66.0	-28.8	-28.9	-29.3	-29.8	-30.6	-31.5	-32.5	-33.5	-34.3	-34.8	-34.8	-34.5	-34.0	-33.6	-33.2	-32.9	-32.7	-32.6	-32.5
68.0	-30.1	-30.3	-30.6	-31.1	-31.9	-32.8	-33.8	-34.8	-35.6	-36.1	-36.1	-35.8	-35.4	-34.9	-34.5	-34.3	-34.1	-33.9	-33.9
70.0	-31.5	-31.6	-32.0	-32.5	-33.3	-34.2	-35.2	-36.2	-37.0	-37.5	-37.6	-37.3	-36.8	-36.3	-36.0	-35.7	-35.5	-35.4	-35.3

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
HORIZONTAL POLARIZATION
FRICTION VELOCITY = 50.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
2.0	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
4.0	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
6.0	9.1	9.1	9.1	9.1	9.1	9.1	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.1	9.1	9.1	9.1	9.1
8.0	8.4	8.4	8.4	8.3	8.3	8.3	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.3	8.3	8.3
10.0	7.5	7.5	7.4	7.4	7.3	7.3	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.3	7.3	7.4	7.4	7.4
12.0	6.3	6.3	6.3	6.2	6.1	6.0	6.0	5.9	5.9	5.9	5.9	5.9	5.9	6.0	6.0	6.1	6.1	6.2	6.2
14.0	5.0	5.0	4.9	4.8	4.7	4.5	4.5	4.4	4.3	4.3	4.3	4.4	4.4	4.5	4.6	4.6	4.7	4.7	4.8
16.0	3.6	3.5	3.4	3.2	3.0	2.9	2.7	2.6	2.5	2.5	2.5	2.6	2.7	2.8	2.9	2.9	3.0	3.1	3.1
18.0	2.0	1.9	1.7	1.4	1.2	1.0	.8	.6	.5	.5	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3
20.0	.4	.3	.0	-.4	-.7	-1.0	-1.3	-1.5	-1.7	-1.8	-1.7	-1.6	-1.4	-1.3	-1.2	-1.0	-.9	-.8	-.7
22.0	-1.0	-1.2	-1.6	-2.1	-2.6	-3.0	-3.4	-3.7	-4.0	-4.1	-4.0	-3.8	-3.7	-3.5	-3.4	-3.2	-3.0	-2.9	-2.8
24.0	-2.2	-2.4	-2.9	-3.6	-4.3	-4.9	-5.3	-5.8	-6.1	-6.3	-6.2	-6.0	-5.7	-5.6	-5.4	-5.3	-5.0	-4.8	-4.8
26.0	-3.2	-3.4	-4.0	-4.8	-5.6	-6.3	-6.9	-7.5	-7.9	-8.1	-8.0	-7.8	-7.5	-7.3	-7.2	-7.0	-6.8	-6.6	-6.5
28.0	-4.1	-4.3	-4.9	-5.8	-6.7	-7.5	-8.2	-8.8	-9.3	-9.6	-9.5	-9.2	-8.9	-8.7	-8.6	-8.4	-8.2	-7.9	-7.8
30.0	-4.9	-5.1	-5.7	-6.6	-7.6	-8.4	-9.1	-9.8	-10.4	-10.7	-10.6	-10.3	-10.0	-9.8	-9.7	-9.5	-9.3	-9.0	-8.9
32.0	-5.8	-6.0	-6.6	-7.5	-8.4	-9.3	-10.1	-10.8	-11.4	-11.7	-11.6	-11.3	-10.9	-10.8	-10.6	-10.5	-10.2	-10.0	-9.9
34.0	-6.8	-7.0	-7.6	-8.5	-9.4	-10.3	-11.1	-11.8	-12.5	-12.8	-12.7	-12.3	-12.0	-11.8	-11.7	-11.5	-11.3	-11.0	-10.9
36.0	-8.1	-8.3	-8.8	-9.6	-10.5	-11.4	-12.3	-13.1	-13.7	-14.0	-14.0	-13.6	-13.2	-13.0	-12.8	-12.6	-12.4	-12.2	-12.1
38.0	-9.6	-9.7	-10.3	-11.0	-11.9	-12.8	-13.7	-14.5	-15.2	-15.5	-15.4	-15.1	-14.7	-14.4	-14.2	-14.0	-13.8	-13.6	-13.5
40.0	-11.0	-11.2	-11.7	-12.4	-13.3	-14.2	-15.1	-15.9	-16.6	-16.9	-16.9	-16.5	-16.1	-15.8	-15.5	-15.3	-15.1	-15.0	-14.9
42.0	-12.4	-12.6	-13.0	-13.7	-14.6	-15.5	-16.4	-17.2	-17.9	-18.3	-18.2	-17.9	-17.5	-17.1	-16.9	-16.6	-16.4	-16.3	-16.2
44.0	-13.7	-13.9	-14.3	-15.0	-15.8	-16.8	-17.7	-18.6	-19.3	-19.6	-19.6	-19.2	-18.8	-18.4	-18.1	-17.9	-17.7	-17.6	-17.5
46.0	-15.0	-15.2	-15.6	-16.3	-17.1	-18.0	-18.9	-19.8	-20.6	-20.9	-20.9	-20.5	-20.1	-19.7	-19.4	-19.2	-19.0	-18.9	-18.8
48.0	-16.3	-16.4	-16.9	-17.5	-18.3	-19.2	-20.2	-21.1	-21.8	-22.2	-22.1	-21.8	-21.3	-20.9	-20.6	-20.4	-20.2	-20.1	-20.0
50.0	-17.5	-17.7	-18.1	-18.7	-19.5	-20.4	-21.4	-22.3	-23.0	-23.4	-23.4	-23.0	-22.6	-22.2	-21.8	-21.6	-21.4	-21.3	-21.2
52.0	-18.8	-18.9	-19.3	-19.9	-20.7	-21.6	-22.6	-23.5	-24.3	-24.7	-24.6	-24.3	-23.8	-23.4	-23.1	-22.9	-22.6	-22.5	-22.4
54.0	-20.0	-20.1	-20.5	-21.1	-21.9	-22.8	-23.8	-24.7	-25.5	-25.9	-25.8	-25.5	-25.1	-24.6	-24.3	-24.0	-23.8	-23.7	-23.6
56.0	-21.2	-21.3	-21.7	-22.3	-23.1	-24.0	-25.0	-25.9	-26.7	-27.1	-27.1	-26.7	-26.3	-25.8	-25.5	-25.2	-25.0	-24.9	-24.9
58.0	-22.4	-22.5	-22.9	-23.5	-24.3	-25.2	-26.1	-27.1	-27.9	-28.3	-28.3	-28.0	-27.5	-27.1	-26.7	-26.4	-26.2	-26.1	-26.1
60.0	-23.6	-23.8	-24.1	-24.7	-25.5	-26.4	-27.3	-28.3	-29.1	-29.5	-29.5	-29.2	-28.8	-28.3	-27.9	-27.7	-27.5	-27.4	-27.3
62.0	-24.9	-25.0	-25.3	-25.9	-26.7	-27.6	-28.6	-29.5	-30.3	-30.8	-30.8	-30.5	-30.0	-29.6	-29.2	-28.9	-28.7	-28.6	-28.6
64.0	-26.1	-26.2	-26.6	-27.2	-27.9	-28.8	-29.8	-30.8	-31.6	-32.1	-32.1	-31.8	-31.3	-30.9	-30.5	-30.2	-30.0	-29.9	-29.8
66.0	-27.4	-27.5	-27.9	-28.4	-29.2	-30.1	-31.1	-32.1	-32.9	-33.4	-33.4	-33.1	-32.6	-32.2	-31.8	-31.5	-31.3	-31.2	-31.2
68.0	-28.7	-28.8	-29.2	-29.7	-30.5	-31.4	-32.4	-33.4	-34.2	-34.7	-34.7	-34.4	-34.0	-33.5	-33.1	-32.9	-32.7	-32.6	-32.5
70.0	-30.1	-30.2	-30.6	-31.1	-31.8	-32.7	-33.8	-34.8	-35.6	-36.1	-36.1	-35.9	-35.4	-34.9	-34.5	-34.3	-34.1	-34.0	-33.9

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 5.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
2.0	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
4.0	13.2	13.2	13.2	13.2	13.2	13.2	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.2	13.2	13.2	13.2	13.2	13.2
6.0	11.4	11.4	11.4	11.4	11.3	11.3	11.3	11.2	11.2	11.2	11.2	11.2	11.3	11.3	11.3	11.4	11.4	11.4	11.4
8.0	8.9	8.9	8.9	8.8	8.7	8.7	8.6	8.6	8.5	8.5	8.5	8.6	8.6	8.7	8.7	8.8	8.9	8.9	8.9
10.0	5.6	5.6	5.5	5.5	5.4	5.3	5.2	5.1	5.0	5.0	5.0	5.1	5.2	5.3	5.4	5.5	5.5	5.6	5.6
12.0	1.5	1.5	1.4	1.3	1.2	1.0	.9	.8	.7	.7	.7	.8	.9	1.0	1.2	1.3	1.4	1.5	1.5
14.0	-3.4	-3.4	-3.5	-3.7	-3.9	-4.1	4.3	-4.4	-4.6	-4.6	-4.6	-4.4	-4.3	-4.1	-3.9	-3.7	-3.6	-3.4	-3.4
16.0	-9.2	-9.2	-9.4	-9.6	-9.8	-10.1	10.4	-10.6	-10.7	-10.8	-10.7	-10.6	-10.4	-10.1	-9.9	-9.6	-9.4	-9.3	-9.2
18.0	-15.7	-15.7	-15.9	-16.3	-16.6	-17.0	-17.3	-17.6	-17.8	-17.9	-17.8	-17.6	-17.4	-17.0	-16.7	-16.3	-16.1	-15.9	-15.8
20.0	-22.2	-22.3	-22.7	-23.2	-23.7	-24.3	-24.8	-25.3	-25.6	-25.7	-25.6	-25.3	-24.8	-24.4	-23.9	-23.5	-23.1	-22.8	-22.7
22.0	-27.2	-27.3	-27.8	-28.6	-29.4	-30.2	-31.0	-31.8	-32.5	-32.8	-32.5	-31.9	-31.2	-30.5	-30.0	-29.4	-28.9	-28.5	-28.4
24.0	-30.1	-30.3	-30.8	-31.6	-32.5	-33.5	[illegible]	-35.6	-36.5	-36.9	-36.5	-35.6	-34.7	-34.0	-33.3	-32.7	-32.2	-31.8	-31.7
26.0	32.2	-32.4	-32.9	-33.6	-34.5	-35.6	-36.7	-37.8	-38.8	-39.2	-38.8	-37.9	-36.9	-36.1	-35.4	-34.8	-34.3	-33.9	-33.8
28.0	-34.0	-34.1	-34.6	-35.3	-36.2	-37.2	[illegible]	-39.6	-40.6	-41.0	-40.5	-39.6	-38.6	-37.7	-37.0	-36.4	-35.9	-35.6	-35.5
30.0	-35.5	-35.7	-36.1	-36.8	-37.7	-38.7	-39.9	-41.1	-42.1	-42.5	-42.1	-41.1	-40.1	-39.2	-38.4	-37.8	-37.3	-37.0	-36.9
32.0	-36.9	-37.1	-37.5	-38.2	-39.0	-40.1	-41.2	-42.5	-43.5	-43.9	-43.4	-42.5	-41.4	-40.5	-39.7	-39.1	-38.6	-38.3	-38.2
34.0	-38.2	-38.3	-38.7	-39.4	-40.2	-41.3	-42.5	-43.7	-44.7	-45.1	-44.7	-43.7	-42.7	-41.7	-40.9	-40.3	-39.8	-39.5	-39.4
36.0	-39.4	-39.5	-39.9	-40.5	-41.3	-42.4	-43.[illegible]	[illegible].8	-45.9	-46.3	-45.8	-44.8	-43.8	-42.8	-42.0	-41.3	-40.8	-40.6	-40.5
38.0	-40.4	-40.5	-40.9	-41.5	-42.4	-43.4	-44.6	-45.7	-46.9	-47.3	-46.8	-45.9	-44.8	-43.8	-42.9	-42.3	-41.8	-41.5	-41.4
40.0	-41.4	-41.5	-41.9	-42.5	-43.3	-44.3	-45.5	-46.8	-47.8	-48.2	-47.8	-46.8	-45.7	-44.7	-43.8	-43.2	-42.7	-42.4	-42.3
42.0	-42.3	-42.4	-42.7	-43.3	-44.2	-45.2	-46.4	-47.7	-48.7	-49.1	-48.7	-47.7	-46.6	-45.5	-44.7	-44.0	-43.5	-43.3	-43.2
44.0	-43.1	-43.2	-43.5	-44.[illegible]	-45.0	-46.0	-47.2	-4[illegible].5	-4[illegible].5	-49.9	-49.5	-48.5	-47.4	-46.3	-45.5	-44.8	-44.3	-44.0	-43.9
46.0	-43.[illegible]	-44.0	-44.3	-44.9	-45.7	-46.7	-48.0	-49.2	-50.3	-50.7	-50.2	-49.2	-48.1	-47.1	-46.2	-45.5	-45.0	-44.7	-44.7
48.0	-44.6	-44.7	-45.[illegible]	-45.[illegible]	-46.[illegible]	-47.[illegible]	-4[illegible].7	-49.9	-51.[illegible]	-51.4	-50.9	-49.9	-48.5	-47.7	-46.9	-46.2	-45.7	-45.4	-45.3
50.0	-45.2	-45.4	-45.7	-46.3	-47.1	-4[illegible].1	-49.[illegible]	-50.6	-51.6	-52.1	-52.[illegible]	-50.6	-49.5	-48.4	-47.5	-46.8	-46.4	-46.1	-46.0
52.0	-45.9	-46.[illegible]	-46.3	-46.9	-47.7	-48.7	-49.9	-51.2	-52.3	-52.7	-52.2	-51.2	-50.1	-49.0	-48.1	-47.4	-47.0	-46.7	-46.6
54.0	-46.5	-46.6	-46.9	-47.[illegible]	-48.3	-49.3	-50.5	-51.8	-52.9	-53.3	-52.9	-51.8	-50.7	-49.6	-48.7	-48.0	-47.5	-47.3	-47.2
56.0	-47.1	-47.2	-47.5	-48.1	-48.9	-49.9	-51.1	-52.4	-53.5	-53.9	-53.4	-52.4	-51.3	-50.2	-49.[illegible]	-48.6	-48.1	-47.8	-47.7
58.0	-47.[illegible]	-47.[illegible]	[illegible]	-48.7	-49.5	-5[illegible]	-51.7	-52.9	-54.0	-54.4	-54.0	-53.0	-51.8	-50.7	-49.	-49.2	-48.7	-48.	-48.3
60.0	[illegible]	-48.3	[illegible]	-49.2	-50.0	-51.0	-52.2	-53.5	-54.6	-55.0	-54.6	-53.6	-52.4	-51.3	-50.4	-49.7	-49.2	-48.[illegible]	-48.8
62.0	-4[illegible].7	[illegible]	-4[illegible].2	-49.7	-50.5	-51.6	-52.6	-54.0	-55.1	-55.5	-55.1	-54.1	-52.9	-51.6	-50.9	-50.3	-49.8	-49.5	-49.4
64.0	-49.3	-49.4	-49.7	-50.3	-51.1	-52.1	-53.3	-54.6	-55.7	-56.1	-55.7	-54.7	-53.5	-52.4	-51.5	-50.8	-50.3	-50.0	-49.9
66.0	-49.8	-50.0	-50.3	-50.8	-51.6	-52.7	-53.9	-55.1	-56.2	-56.7	-56.3	-55.3	-54.1	-53.0	-52.[illegible]	-51.4	-50.9	-50.6	-50.5
68.0	-50.4	-50.5	-50.9	-51.4	-52.2	-53.2	-54.4	-55.7	-56.8	-57.3	-56.9	-55.9	-54.7	-53.6	-52.7	-52.0	-51.5	-51.2	-51.1
70.0	-51.0	-51.1	-51.5	-52.0	-52.8	-53.8	-55.1	-56.3	-57.4	-57.9	-57.5	-56.5	-55.3	-54.3	-53.4	-52.7	-52.2	-51.9	-51.8

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 10.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
2.0	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
4.0	11.9	11.9	11.9	11.9	11.9	11.9	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.9	11.9	11.9	11.9	11.9	11.9
6.0	10.7	10.7	10.7	10.7	10.7	10.7	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.7	10.7	10.7	10.7	10.7	10.7
8.0	9.1	9.1	9.1	9.0	9.0	9.0	8.9	8.9	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.1	9.1
10.0	7.0	7.0	6.9	6.9	6.8	6.7	6.7	6.6	6.6	6.6	6.6	6.6	6.7	6.7	6.8	6.9	6.9	7.0	7.0
12.0	4.3	4.3	4.3	4.2	4.1	4.0	3.9	3.9	3.8	3.8	3.8	3.8	3.9	4.0	4.1	4.2	4.3	4.3	4.3
14.0	1.2	1.1	1.1	1.0	.8	.7	.6	.5	.4	.4	.4	.5	.6	.7	.8	1.0	1.1	1.1.	1.2
16.0	-2.5	-2.6	-2.7	-2.8	-3.0	-3.2	-3.4	-3.5	-3.6	-3.6	-3.6	-3.5	-3.4	-3.2	-3.0	-2.9	-2.7	-2.6	-2.6
18.0	-6.8	-6.9	[illegible]	-7.2	-7.4	-7.7	-7.9	-8.1	-8.2	-8.3	-8.2	-8.1	-7.9	-7.7	-7.5	-7.2	-7.1	-6.9	-6.9
20.0	-11.5	-11.5	-11.7	-12.0	-12.4	-12.7	-13.0	-13.3	-13.5	-13.5	-13.5	[illegible]	-13.0	-12.8	-12.5	-12.2	-11.9	-11.7	-11.7
22.0	-16.0	-16.1	-16.5	-16.9	-17.4	-17.9	-18.4	-18.9	-19.1	-19.2	-19.1	[illegible]	-18.5	-18.1	-17.7	-17.3	-16.9	-16.7	-16.6
24.0	-19.5	[illegible]	[illegible]	-21.0	-21.7	-22.4	-23.1	-23.8	-24.4	-24.6	-24.4	-23.8	-23.3	-22.7	-22.2	-21.7	-21.3	-20.9	-20.8
26.0	-21.9	-22.1	-22.6	-23.4	-24.4	-25.3	-26.2	-27.1	[illegible]	-28.3	-28.0	-27.2	-26.4	-25.7	-25.1	-24.6	-24.0	-23.5	-23.5
28.0	-23.2	-23.7	-24.3	-25.1	-26.0	-27.0	-28.0	-27.1	-30.1	-30.5	-30.1	-29.2	-28.3	-27.5	-26.9	-26.3	-25.7	-25.3	-25.2
30.0	-25.2	-25.3	-25.9	[illegible]	-27.6	-28.6	-29.7	-30.8	-31.8	-32.2	-31.8	-30.8	-29.9	-29.1	-28.4	-27.8	-27.3	-26.9	-26.8
32.0	[illegible]	-26.6	-27.5	-28.1	-29.0	-30.0	-31.1	-32.3	-33.3	-33.7	-33.2	-32.3	-31.3	-30.5	-29.8	-29.1	-28.6	-28.3	-28.2
34.0	[illegible]	-28.2	-28.6	-29.3	-30.2	-31.2	-32.4	-33.6	-34.6	-35.0	-34.6	-33.6	-32.6	-31.7	-31.0	-30.4	-29.9	-29.5	-29.4
36.0	-29.2	-29.4	-29.8	-30.5	-31.4	-32.4	-33.6	-34.7	-35.9	-36.2	-35.7	-34.8	-33.6	-32.8	-32.1	-31.5	-31.0	-30.7	-30.6
38.0	-30.3	-30.5	-30.9	-31.5	-32.4	-33.4	-34.6	-35.9	-36.9	-37.3	-36.8	-35.9	-34.8	-33.9	-33.1	-32.5	-32.0	-31.7	-31.6
40.0	-31.3	-31.5	-31.9	-32.5	-33.4	-34.4	-35.6	-36.8	-37.9	-38.3	-37.8	-36.9	-35.8	-34.8	-34.0	-33.4	-32.9	-32.6	-32.5
42.0	-32.3	-32.4	-32.8	-33.4	-34.3	-35.3	-36.5	-37.7	-38.8	-39.2	-38.7	-37.9	-36.7	-35.7	-34.9	-34.2	-33.8	-33.5	-33.4
44.0	-33.2	-33.3	-33.6	-34.3	-35.1	-36.1	-37.3	-38.6	-39.5	-40.0	-39.6	-38.6	-37.5	-36.5	-35.7	-35.0	-34.6	-34.3	-34.2
46.0	-33.7	-34.1	-34.4	-35.0	-35.9	-36.9	-38.1	-39.4	-40.4	-40.3	-40.4	-39.4	-38.3	-37.3	-36.4	-35.8	-35.3	-35.0	-34.9
48.0	-34.7	-34.8	-35.2	-35.8	-36.6	-37.6	-38.8	-40.1	-41.1	-41.5	-41.1	-40.1	-39.0	-38.0	-37.1	-36.5	-36.0	-35.7	-35.6
50.0	-35.4	-35.5	-35.8	-36.4	-37.3	-38.3	-39.5	-40.8	[illegible]	-42.2	-41.8	-40.8	-39.7	-38.6	-37.8	-37.1	-36.6	-36.4	-36.3
52.0	-36.0	-36.1	-36.5	-37.1	-37.9	-38.9	-40.1	-41.4	-42.5	-42.9	-42.4	-41.4	-40.3	-39.3	-38.4	-37.7	-37.3	-37.0	-36.9
54.0	-36.6	-36.8	-37.1	-37.7	-38.5	-39.5	-40.8	-42.0	-43.1	-43.5	-43.1	-42.1	-40.9	-39.9	-39.0	-38.3	-37.9	-37.6	-37.5
56.0	-37.2	-37.4	-37.7	-38.3	-39.1	-40.1	-41.3	-42.6	-43.7	-44.1	-43.7	-42.7	-41.5	-40.5	-39.6	-38.9	-38.4	-38.1	-38.0
58.0	-37.8	-37.9	-38.3	-38.9	-39.7	-40.7	-41.9	-43.2	-44.3	-44.7	-44.2	-43.2	-42.1	-41.0	-40.2	-39.5	-39.0	-38.7	-38.6
60.0	-38.4	-38.5	-38.8	-39.4	-40.2	-41.3	-42.5	-43.7	-44.8	-45.2	-44.8	-43.8	-42.7	-41.6	-40.7	-40.0	-39.5	-39.3	-39.2
62.0	-38.9	-39.1	-39.4	-40.0	-40.8	-41.8	-43.0	-44.3	-45.4	-45.8	-45.4	-44.4	-43.2	-42.2	-41.3	-40.6	-40.1	-39.9	-39.7
64.0	-39.5	-39.6	-39.9	-40.5	-41.3	-42.4	-43.6	-44.9	-45.9	-46.4	-46.0	-45.0	-43.8	-42.7	-41.8	-41.2	-40.7	-40.4	-40.3
66.0	-40.1	-40.2	-40.5	-41.1	-41.9	-42.9	-44.1	-45.4	-46.5	-47.0	-46.5	-45.5	-44.4	-43.3	-42.4	-41.7	-41.3	41.0	-40.9
68.0	-40.6	-40.7	-41.1	-41.7	-42.5	-43.5	-44.7	-46.0	-47.1	-47.6	-47.2	-46.2	-45.0	-43.9	-43.1	-42.4	-41.9	-41.6	-41.5
70.0	-41.2	-41.3	-41.7	-42.3	-43.1	-44.1	-45.3	-46.6	-47.7	-48.2	-47.8	-46.8	-45.7	-44.6	-43.7	-43.0	-42.6	-42.3	-42.2

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 15.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
2.0	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
4.0	11.2	11.2	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.2	11.2
6.0	10.2	10.2	10.2	10.2	10.2	10.2	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2	10.2	10.2
8.0	8.9	8.9	8.9	8.9	8.8	8.8	8.8	8.7	8.7	8.7	8.7	8.7	8.8	8.8	8.8	8.9	8.9	8.9	8.9
10.0	7.2	7.2	7.2	7.1	7.1	7.0	7.0	6.9	6.9	6.9	6.9	6.9	7.0	7.0	7.1	7.1	7.2	7.2	7.2
12.0	5.1	5.1	5.1	5.0	4.9	4.8	4.8	4.7	4.7	4.6	4.7	4.7	4.8	4.8	4.9	5.0	5.1	5.1	5.1
14.0	2.6	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.9	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.5	2.6
16.0	-.4	-.4	-.5	-.6	-.8	-.9	-1.1	-1.2	-1.3	-1.3	-1.3	-1.2	-1.1	-.9	-.8	-.6	-.5	-.4	-.4
18.0	-3.8	-3.8	-3.9	-4.1	-4.3	-4.5	-4.7	-4.9	-5.0	-5.0	-5.0	-4.9	-4.7	-4.5	-4.3	-4.1	-4.0	-3.9	-3.9
20.0	-7.4	-7.5	-7.7	-8.0	-8.2	-8.5	-8.8	-9.0	-9.2	-9.2	-9.2	-9.0	-8.8	-8.6	-8.3	-8.1	-7.9	-7.7	-7.7
22.0	-11.1	-11.3	-11.6	-12.0	-12.4	-12.8	-13.2	-13.5	-13.8	-13.9	-13.8	-13.5	-13.2	-12.9	-12.6	-12.3	-12.0	-11.8	-11.7
24.0	-14.3	-14.5	-14.9	-15.5	-16.2	-16.8	-17.4	-17.9	-18.3	-18.5	-18.3	-17.9	-17.5	-17.0	-16.6	-16.2	-15.8	-15.4	-15.3
26.0	-16.5	-16.7	-17.3	-18.0	-18.9	-19.7	-20.5	-21.3	-22.0	-22.3	-22.0	-21.3	-20.7	-20.1	-19.6	-19.1	-18.5	-18.1	-18.0
28.0	-17.9	-18.2	-18.8	-19.6	-20.5	-21.5	-22.4	-23.4	-24.3	-24.7	-24.3	-23.5	-22.6	-22.0	-21.4	-20.8	-20.2	-19.8	-19.7
30.0	-19.2	-19.4	-20.0	-20.8	-21.8	-22.8	-23.8	-24.8	-25.8	-26.2	-25.8	-24.9	-24.0	-23.3	-22.6	-22.0	-21.5	-21.1	-20.9
32.0	-20.6	-20.8	-21.3	-22.1	-23.1	-24.1	-25.1	-26.2	-27.2	-27.6	-27.2	-26.3	-25.3	-24.6	-23.9	-23.3	-22.8	-22.4	-22.2
34.0	-22.0	-22.2	-22.7	-23.4	-24.3	-25.4	-26.5	-27.6	-28.6	-29.0	-28.6	-27.6	-26.7	-25.8	-25.1	-24.5	-24.0	-23.7	-23.6
36.0	-23.3	-23.4	-23.9	-24.6	-25.5	-26.5	-27.7	-28.9	-29.9	-30.3	-29.8	-28.9	-27.9	-27.0	-26.3	-25.7	-25.2	-24.8	-24.7
38.0	-24.4	-24.6	-25.0	-25.7	-26.6	-27.6	-28.8	-30.0	-31.0	-31.4	-30.9	-30.0	-29.0	-28.1	-27.3	-26.7	-26.2	-25.9	-25.8
40.0	-25.4	-25.6	-26.0	-26.7	-27.6	-28.6	-29.8	-31.0	-32.0	-32.4	-32.0	-31.0	-30.0	-29.0	-28.3	-27.6	-27.2	-26.9	-26.7
42.0	-26.4	-26.5	-27.0	-27.6	-28.5	-29.5	-30.7	-31.9	-32.9	-33.3	-32.9	-31.9	-30.9	-29.9	-29.1	[illegible]	-28.0	-27.7	-27.6
44.0	-27.3	-27.4	-27.8	-28.5	-29.3	-30.4	-31.5	-32.8	-33.8	-34.2	-33.8	-32.8	-31.7	-30.7	-29.9	-29.3	-28.8	-28.5	-28.4
46.0	-28.1	-28.2	-28.6	-29.3	-30.1	-31.1	-32.3	-33.6	-34.6	-35.0	-34.6	-33.6	-32.5	-31.5	-30.7	-30.1	-29.6	-29.3	-29.2
48.0	-28.9	-29.0	-29.4	-30.0	-30.8	-31.9	-33.1	-34.3	-35.4	-35.8	-35.3	-34.3	-33.2	-32.2	-31.4	-30.8	-30.3	-30.0	-29.9
50.0	-29.6	-29.7	-30.1	-30.7	-31.5	-32.6	-33.8	-35.0	-36.1	-36.5	-36.0	-35.0	-33.9	-32.9	-32.1	-31.4	-30.9	-30.7	-30.6
52.0	-30.2	-30.4	-30.7	-31.3	-32.2	-33.2	-34.4	-35.7	-36.7	-37.1	-36.7	-35.7	-34.6	-33.6	-32.7	-32.0	-31.6	-31.3	-31.2
54.0	-30.9	-31.0	-31.4	-32.0	-32.8	-33.8	-35.0	-36.3	-37.4	-37.8	-37.3	-36.3	-35.2	-34.2	-33.3	-32.7	-32.2	-31.9	-31.8
56.0	-31.5	-31.6	-32.0	-32.6	-33.4	-34.4	-35.6	-36.9	-38.0	-38.4	-37.9	-36.9	-35.8	-34.8	-33.9	-33.2	-32.8	-32.5	-32.4
58.0	-32.1	-32.2	-32.5	-33.1	-33.9	-35.0	-36.2	-37.5	-38.5	-39.0	-38.5	-37.5	-36.4	-35.3	-34.5	-33.8	-33.3	-33.0	-32.9
60.0	-32.6	-32.8	-33.1	-33.7	-34.5	-35.5	-36.8	-38.0	-39.1	-39.5	-39.1	-38.1	-37.0	-35.9	-35.0	-34.4	-33.9	-33.6	-33.5
62.0	-33.2	-33.3	-33.7	-34.2	-35.1	-36.1	-37.3	-38.6	-39.7	-40.1	-39.7	-38.7	-37.5	-36.5	-35.6	-34.9	-34.5	-34.2	-34.1
64.0	-33.8	-33.9	-34.2	-34.6	-35.6	-36.6	-37.9	-39.2	-40.2	-40.7	-40.3	-39.3	-38.1	-37.1	-36.2	-35.5	-35.0	-34.7	-34.7
66.0	-34.3	-34.4	-34.8	-35.4	-36.2	-37.2	-38.4	-39.7	-40.9	-41.3	-40.9	-39.9	-38.7	37.7	-36.8	-36.1	-35.6	-35.3	-35.3
68.0	-34.9	-35.0	-35.4	-35.9	-36.8	-37.8	-39.0	-40.3	-41.4	-41.9	-41.5	-40.5	-39.3	-38.3	-37.4	-36.7	-36.3	-36.0	-35.9
70.0	-35.5	-35.6	-36.0	-36.6	-37.4	-38.4	-39.6	-40.9	-42.0	-42.5	-42.1	-41.2	-40.0	-39.0	-38.1	-37.4	-36.9	-36.7	-36.6

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 20.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3
2.0	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
4.0	10.7	10.7	10.7	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.7	10.7	10.7
6.0	9.9	9.9	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.9	9.9
8.0	8.7	8.7	8.7	8.7	8.7	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.7	8.7	8.7	8.7	8.7
10.0	7.3	7.3	7.2	7.2	7.1	7.1	7.1	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.2	7.2	7.3	7.3
12.0	5.5	5.4	5.4	5.3	5.3	5.2	5.1	5.1	5.0	5.0	5.0	5.1	5.1	5.2	5.3	5.3	5.4	5.4	5.4
14.0	3.3	3.3	3.2	3.1	3.0	2.9	2.8	2.8	2.7	2.7	2.7	2.8	2.8	2.9	3.0	3.1	3.2	3.2	3.3
16.0	.7	.7	.6	.5	.4	.2	.1	.0	-.1	-.1	-.1	.0	.1	.2	.4	.5	.6	.7	.7
18.0	-2.1	-2.2	-2.3	-2.5	-2.7	-2.8	-3.0	-3.2	-3.3	-3.3	-3.3	-3.2	-3.0	-2.9	-2.7	-2.5	-2.4	-2.3	-2.3
20.0	-5.2	-5.3	-5.5	-5.8	-6.0	-6.3	-6.5	-6.7	-6.9	-6.9	-6.9	-6.7	-6.5	-6.3	-6.1	-5.9	-5.7	-5.6	-5.5
22.0	-8.4	-8.5	-8.8	-9.2	-9.6	-9.9	-10.3	-10.6	-10.8	-10.9	-10.8	-10.6	-10.3	-10.0	-9.8	-9.5	-9.2	-9.0	-8.9
24.0	-11.0	-11.2	-11.6	-12.2	-12.9	-13.4	-13.9	-14.4	-14.8	-15.0	-14.8	-14.4	-14.0	-13.6	-13.2	-12.8	-12.5	-12.2	-12.0
26.0	-13.0	-13.2	-13.7	-14.5	-15.3	-16.1	-16.8	-17.6	-18.2	-18.5	-18.2	-17.6	-17.0	-16.5	-16.0	-15.5	-15.0	-14.6	-14.4
28.0	-14.3	-14.5	-15.1	-16.0	-16.9	-17.8	-18.7	-19.6	-20.5	-20.8	-20.4	-19.6	-18.9	-18.3	-17.7	-17.1	-16.6	-16.1	-16.0
30.0	-15.3	-15.5	-16.1	-17.0	-18.0	-18.9	-19.9	-20.9	-21.9	-22.3	-21.9	-21.0	-20.1	-19.4	-18.8	-18.2	-17.7	-17.2	-17.1
32.0	-16.4	-16.6	-17.2	-18.0	-19.0	-20.0	-21.0	-22.1	-23.1	-23.5	-23.0	-22.1	-21.2	-20.5	-19.9	-19.3	-18.7	-18.3	-18.1
34.0	-17.7	-17.9	-18.4	-19.2	-20.2	-21.2	-22.2	-23.4	-24.4	-24.8	-24.3	-23.4	-22.5	-21.7	-21.0	-20.4	-19.9	-19.5	-19.4
36.0	-19.0	-19.2	-19.7	-20.4	-21.4	-22.4	-23.5	-24.6	-25.6	-26.0	-25.6	-24.7	-23.7	-22.9	-22.2	-21.5	-21.0	-20.7	-20.6
38.0	-20.2	-20.4	-20.8	-21.5	-22.4	-23.5	-24.6	-25.8	-26.8	-27.2	-26.7	-25.8	-24.8	-23.9	-23.2	-22.6	-22.1	-21.8	-21.6
40.0	-21.3	-21.4	-21.9	-22.6	-23.4	-24.5	-25.6	-26.8	-27.8	-28.2	-27.8	-26.8	-25.8	-24.9	-24.2	-23.5	-23.1	-22.7	-22.6
42.0	-22.2	-22.4	-22.8	-23.5	-24.4	-25.4	-26.6	-27.9	-28.8	-29.2	-28.7	-27.8	-26.7	-25.8	-25.0	-24.4	-23.9	-23.6	-23.5
44.0	-23.1	-23.3	-23.7	-24.3	-25.2	-26.2	-27.4	-28.7	-29.7	-30.1	-29.6	-28.7	-27.6	-26.7	-25.9	-25.2	-24.8	-24.5	-24.4
46.0	-24.0	-24.1	-24.5	-25.1	-26.0	-27.0	-28.2	-29.5	-30.5	-30.9	-30.5	-29.5	-28.4	-27.4	-26.6	-26.0	-25.5	-25.2	-25.1
48.0	-24.7	-24.9	-25.3	-25.9	-26.7	-27.8	-29.0	[illegible]	-31.3	-31.7	-31.2	-30.2	-29.2	-28.2	-27.3	-26.7	-26.2	-25.9	-25.8
50.0	-25.5	-25.6	-26.0	-26.6	-27.4	-28.5	-29.7	-30.9	-32.0	-32.4	-31.9	-31.0	-29.9	-28.9	-28.0	-27.4	-26.9	-26.6	-26.5
52.0	-26.1	-26.3	-26.6	-27.3	-28.1	-29.1	-30.3	-31.6	-32.6	-33.0	-32.6	-31.6	-30.5	-29.5	-28.7	-28.0	-27.5	-27.2	-27.1
54.0	-26.8	-26.9	-27.3	-27.9	-28.7	-29.7	-31.0	-32.2	-33.3	-33.7	-33.2	-32.3	-31.1	-30.1	-29.3	-28.6	-28.1	-27.9	-27.8
56.0	-27.4	-27.5	-27.9	-28.5	-29.3	-30.3	-31.6	-32.8	-33.9	-34.3	-33.9	-32.9	-31.8	-30.7	-29.9	-29.2	-28.7	-28.4	-28.3
58.0	-28.0	-28.1	-28.5	-29.1	-29.9	-30.9	-32.1	-33.4	-34.5	-34.9	-34.5	-33.5	-32.3	-31.3	-30.4	-29.8	-29.3	-29.0	-28.9
60.0	-28.6	-28.7	-29.0	-29.6	-30.4	-31.5	-32.7	[illegible]	-35.0	-35.5	-35.0	-34.1	-32.9	-31.9	-31.0	-30.3	-29.9	-29.6	-29.5
62.0	-29.1	-29.2	-29.6	-30.2	-31.0	-32.0	-33.3	[illegible]	-35.6	-36.1	-35.6	-34.6	-33.5	-32.5	-31.6	-30.9	-30.4	-30.2	-30.1
64.0	-29.7	-29.8	-30.2	-30.7	-31.6	-32.6	-33.8	-35.1	-36.2	-36.6	-36.2	-35.2	-34.1	-33.0	-32.2	-31.5	-31.0	-30.7	-30.6
66.0	-30.3	-30.4	-30.7	-31.3	-32.1	-33.2	-34.4	-35.7	-36.8	-37.2	-36.8	-35.8	-34.7	-33.6	-32.8	-32.1	-31.6	-31.3	-31.2
68.0	-30.8	-31.0	-31.3	-31.9	-32.7	-33.7	-35.0	-36.3	-37.4	-37.8	-37.4	-36.5	-35.3	-34.3	-33.4	-32.7	-32.3	-32.0	-31.9
70.0	-31.4	-31.6	-31.9	-32.5	-33.3	-34.4	-35.6	-36.9	-38.0	-38.5	-38.1	-37.1	-36.0	-35.0	-34.1	-33.4	-33.0	-32.7	-32.6

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 25.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
2.0	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
4.0	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.2	10.2	10.2	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
6.0	9.6	9.6	9.6	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.6	9.6	9.6
8.0	8.6	8.6	8.5	8.5	8.5	8.5	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.5	8.5	8.5	8.5	8.6	8.6
10.0	7.3	7.2	7.2	7.2	7.1	7.1	7.1	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.2	7.2	7.2	7.2
12.0	5.6	5.6	5.6	5.5	5.5	5.4	5.3	5.3	5.2	5.2	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.6	5.6
14.0	3.7	3.7	3.6	3.5	3.4	3.3	3.3	3.2	3.1	3.1	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.6	3.7
16.0	1.4	1.4	1.3	1.2	1.1	1.0	.8	.7	.7	.6	.7	.7	.8	.9	1.1	1.2	1.3	1.3	1.4
18.0	-1.1	-1.1	-1.3	-1.4	-1.6	-1.8	-2.0	-2.1	-2.2	-2.2	-2.2	-2.1	-2.0	-1.8	-1.7	-1.5	-1.4	-1.3	-1.2
20.0	-3.8	-3.9	-4.1	-4.3	-4.6	-4.8	-5.1	-5.3	-5.4	-5.5	-5.4	-5.3	-5.1	-4.9	-4.7	-4.5	-4.3	-4.2	-4.1
22.0	-6.4	-6.6	-6.9	-7.3	-7.7	-8.1	-8.4	-8.7	-8.9	-9.0	-8.9	-8.7	-8.4	-8.2	-7.9	-7.6	-7.3	-7.1	-7.1
24.0	-8.7	-8.9	-9.3	-9.9	-10.6	-11.1	-11.6	-12.1	-12.5	-12.6	-12.5	-12.1	-11.7	-11.3	-11.0	-10.6	-10.2	-9.9	-9.8
26.0	-10.4	-10.6	-11.2	-11.9	-12.8	-13.5	-14.2	-14.9	-15.5	-15.8	-15.5	-14.9	-14.3	-13.8	-13.4	-12.9	-12.4	-12.0	-11.9
28.0	-11.5	-11.8	-12.4	-13.2	-14.2	-15.1	-15.9	-16.8	-17.6	-18.0	-17.6	-16.8	-16.1	-15.5	-15.0	-14.4	-13.9	-13.4	-13.2
30.0	-12.4	-12.7	-13.3	-14.2	-15.1	-16.1	-17.0	-18.0	-19.0	-19.4	-18.9	-18.1	-17.2	-16.6	-16.0	-15.4	-14.8	-14.4	-14.2
32.0	-13.4	-13.6	-14.2	-15.0	-16.0	-17.0	-18.0	-19.0	-20.0	-20.4	-20.0	-19.1	-18.2	-17.5	-16.9	-16.3	-15.7	-15.3	-15.1
34.0	-14.4	-14.6	-15.2	-16.0	-17.0	-18.0	-19.0	-20.1	-21.1	-21.5	-21.1	-20.1	-19.2	-18.5	-17.8	-17.2	-16.7	-16.3	-16.1
36.0	-15.7	-15.9	-16.4	-17.2	-18.1	-19.1	-20.2	-21.4	-22.3	-22.8	-22.3	-21.4	-20.4	-19.6	-19.0	-18.3	-17.8	-17.5	-17.3
38.0	-16.9	-17.1	-17.6	-18.3	-19.2	-20.3	-21.4	-22.5	-23.5	-23.9	-23.5	-22.5	-21.6	-20.7	-20.[illegible]	-19.4	-18.9	-18.5	-18.4
40.0	-18.0	-18.2	-18.6	-19.3	-20.2	-21.3	-22.4	-23.6	-24.6	-25.0	-24.5	-23.6	-22.6	-21.7	-21.0	-20.4	-19.9	-19.5	-19.4
42.0	-19.0	-19.1	-19.6	-20.3	-21.2	-22.2	-23.3	-24.5	-25.6	-26.0	-25.5	-24.6	-23.5	-22.6	-21.9	-21.3	-20.8	-20.5	-20.3
44.0	-19.9	-20.0	-20.5	-21.1	-22.0	-23.1	-24.2	-25.4	-26.5	-26.9	-26.4	-25.5	-24.4	-23.5	-22.7	-22.1	-21.6	-21.3	-21.2
46.0	-20.7	-20.9	-21.3	-22.0	-22.9	-23.9	-25.0	-26.3	-27.3	-27.7	-27.2	-26.3	-25.2	-24.3	-23.5	-22.8	-22.4	-22.1	-22.0
48.0	-21.5	-21.7	-22.1	-22.7	-23.6	-24.6	-25.8	-27.0	-28.1	-28.5	-28.0	-27.1	-26.0	-25.0	-24.2	-23.6	-23.1	-22.8	-22.7
50.0	-22.3	-22.4	-22.8	-23.4	-24.3	-25.3	-26.5	-27.7	-28.8	-29.2	-28.7	-27.8	-26.7	-25.7	-24.9	-24.2	-23.8	-23.5	-23.4
52.0	-22.9	-23.1	-23.5	-24.1	-24.9	-26.0	-27.2	-28.4	-29.5	-29.9	-29.4	-28.5	-27.4	-26.4	-25.5	-24.9	-24.4	-24.1	-24.0
54.0	-23.6	-23.7	-24.1	-24.7	-25.6	-26.6	-27.8	-29.1	-30.1	-30.5	-30.1	-29.1	-28.0	-27.0	-26.1	-25.5	-25.0	-24.7	-24.6
56.0	-24.2	-24.3	-24.7	-25.3	-26.2	-27.2	-28.4	-29.7	-30.7	-31.1	-30.7	-29.7	-28.6	-27.6	-26.7	-26.1	-25.6	-25.3	-25.2
58.0	-24.8	-24.9	-25.3	-25.9	-26.7	-27.3	-29.0	-30.3	-31.3	-31.7	-31.3	-30.3	-29.2	-28.2	-27.3	-26.7	-26.2	-25.9	-25.8
60.0	-25.4	-25.5	-25.9	-26.5	-27.3	-28.3	-29.6	-30.8	-31.9	-32.3	-31.9	-30.9	-29.8	-28.8	-27.9	-27.2	-26.8	-26.5	-26.4
62.0	-26.0	-26.1	-26.4	-27.0	-27.9	-28.9	-30.1	-31.4	-32.5	-32.9	-32.5	-31.5	-30.4	-29.3	-28.5	-27.8	-27.3	-27.0	-26.9
64.0	-26.5	-26.6	-27.0	-27.6	-28.4	-29.5	-30.7	-32.0	-33.0	-33.5	-33.1	-32.1	-31.0	-29.9	-29.1	-28.4	-27.9	-27.6	-27.5
66.0	-27.1	-27.2	-27.6	-28.2	-29.0	-30.0	-31.2	-32.5	-33.6	-34.1	-33.7	-32.7	-31.6	-30.5	-29.7	-29.0	-28.5	-28.2	-28.1
68.0	-27.7	-27.8	-28.2	-28.7	-29.6	-30.6	-31.8	-33.1	-34.2	-34.7	-34.3	-33.3	-32.2	-31.2	-30.3	-29.6	-29.2	-28.9	-28.8
70.0	-28.3	-28.4	-28.8	-29.4	-30.2	-31.2	-32.5	-33.8	-34.9	-35.4	-35.0	-34.0	-32.9	-31.9	-31.0	-30.3	-29.9	-29.6	-29.5

ORIGINAL PAGE IS OF POOR QUALITY

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 30.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
2.0	0.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
4.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
6.0	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
8.0	8.4	8.4	8.4	8.4	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.4	8.4
10.0	7.2	7.2	7.2	7.1	7.1	7.1	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.2	7.2	7.2
12.0	5.7	5.7	5.7	5.6	5.6	5.5	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.6	5.6	5.7	5.7	5.7
14.0	4.0	4.0	3.9	3.8	3.7	3.6	3.6	3.5	3.4	3.4	3.4	3.5	3.5	3.6	3.7	3.8	3.9	3.9	3.9
16.0	1.9	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.2	1.1	1.2	1.2	1.3	1.4	1.5	1.7	1.8	1.8	1.8
18.0	-.3	-.4	-.5	-.7	-.9	-1.1	-1.2	-1.3	-1.4	-1.5	-1.4	-1.3	-1.2	-1.1	-.9	-.8	-.6	-.5	-.5
20.0	-2.7	-2.8	-3.0	-3.3	-3.6	-3.8	-4.0	-4.2	-4.4	-4.4	-4.4	-4.2	-4.1	-3.9	-3.7	-3.5	-3.3	-3.1	-3.1
22.0	-5.0	-5.1	-5.5	-5.9	-6.3	-6.7	-7.0	-7.3	-7.6	-7.6	-7.5	-7.3	-7.1	-6.8	-6.5	-6.3	-6.0	-5.8	-5.7
24.0	-7.0	-7.1	-7.6	-8.2	-8.8	-9.4	-9.9	-10.3	-10.7	-10.9	-10.7	-10.3	-9.9	-9.6	-9.2	-8.9	-8.5	-8.2	-8.1
26.0	[illegible]	-8.6	-9.2	-10.0	-10.8	-11.5	-12.2	-12.9	-13.5	-13.7	[illegible]	-12.9	-12.3	-11.8	-11.4	-10.9	-10.4	-10.0	-9.9
28.0	-9.4	-9.6	-10.2	-11.1	-12.0	-12.9	-13.7	-14.6	-15.4	-15.8	-15.4	-14.6	-13.9	-13.3	-12.8	-12.3	-11.7	-11.3	-11.1
30.0	-10.1	-10.4	-11.0	-11.9	-12.9	-13.8	-14.7	-15.7	-16.6	-17.0	-16.6	-15.7	-14.9	-14.3	-13.8	-13.2	-12.6	-12.1	-12.0
32.0	-10.9	-11.2	-11.8	-12.7	-13.6	-14.6	-15.6	-16.6	-17.6	-18.0	-17.5	-16.6	-15.8	-15.1	-14.5	-13.9	-13.3	-12.9	-12.7
34.0	-11.9	-12.1	-12.7	-13.5	-14.5	-15.5	-16.5	-17.5	-18.5	-18.9	-18.5	-17.6	-16.7	-16.0	-15.3	-14.7	-14.2	-13.8	-13.6
36.0	-13.0	-13.2	-13.8	-14.6	-15.5	-16.5	-17.6	-18.7	-19.7	-20.1	-19.6	-18.7	-17.8	-17.0	-16.3	-15.7	-15.2	-14.8	-14.7
38.0	-14.2	-14.4	-14.9	-15.7	-16.6	-17.6	-18.7	-19.9	-20.8	-21.3	-20.8	-19.9	-18.9	-18.1	-17.4	-16.8	-16.3	-15.9	-15.8
40.0	-15.3	-15.5	-16.0	-16.7	-17.6	-18.6	-19.8	-20.9	-21.9	-22.3	-21.9	-20.9	-20.0	-19.1	-18.4	-17.8	-17.3	-16.9	-16.8
42.0	-16.3	-16.5	-17.0	-17.7	-18.6	-19.6	-20.7	-21.9	-22.9	-23.3	-22.9	-21.9	-20.9	-20.0	-19.3	-18.7	-18.2	-17.8	-17.7
44.0	-17.3	-17.4	-17.9	-18.5	-19.4	-20.5	-21.6	-22.8	-23.8	-24.2	-23.8	-22.8	-21.8	-20.9	-20.1	-19.5	-19.0	-18.7	-18.6
46.0	-18.1	-18.3	-18.7	-19.4	-20.2	-21.3	-22.4	-23.6	-24.7	-25.1	-24.6	-23.7	-22.6	-21.7	-20.9	-20.3	-19.8	-19.5	-19.4
48.0	-18.9	-19.0	-19.5	-20.1	-21.0	-22.0	-23.2	-24.4	-25.5	-25.9	-25.4	-24.4	-23.4	-22.4	-21.6	-21.0	-20.5	-20.2	-20.1
50.0	-19.6	-19.8	-20.2	-20.8	-21.7	-22.7	-23.9	-25.1	-26.2	-26.6	-26.1	-25.2	-24.1	-23.1	-22.3	-21.7	-21.2	-20.9	-20.8
52.0	-20.3	-20.5	-20.9	-21.5	-22.3	-23.4	-24.6	-25.8	-26.9	-27.3	-26.8	-25.9	-24.8	-23.8	-23.0	-22.3	-21.8	-21.5	-21.4
54.0	-21.0	-21.1	-21.5	-22.1	-23.0	-24.0	-25.2	-26.5	-27.5	-27.9	-27.5	-26.5	-25.4	-24.4	-23.6	-22.9	-22.5	-22.2	-22.1
56.0	-21.6	-21.7	-22.1	-22.7	-23.6	-24.6	-25.8	-27.1	-28.1	-28.6	-28.1	-27.1	-26.0	-25.0	-24.2	-23.5	-23.0	-22.8	-22.7
58.0	-22.2	-22.3	-22.7	-23.3	-24.2	-25.2	-26.4	-27.7	-28.7	-29.2	-28.7	-27.7	-26.6	-25.6	-24.8	-24.1	-23.6	-23.3	-23.2
60.0	-22.8	-22.9	-23.3	-23.9	-24.7	-25.8	-27.0	-28.3	-29.3	-29.8	-29.3	-28.3	-27.2	-26.2	-25.3	-24.7	-24.2	-23.9	-23.8
62.0	-23.4	-23.5	-23.9	-24.5	-25.3	-26.3	-27.5	-28.9	-29.9	-30.3	-29.9	-28.9	-27.8	-26.8	-25.9	-25.8	-24.8	-24.9	-24.4
64.0	-23.9	-24.1	-24.4	-25.0	-25.8	-26.9	-28.1	-29.4	-30.5	-30.9	-30.5	-29.5	-28.4	-27.4	-26.9	-25.8	-25.4	-25.1	-25.0
66.0	-24.5	-24.6	-25.0	-25.6	-26.4	-27.5	-28.7	-30.0	-31.1	-31.5	-31.1	-30.1	-29.0	-28.0	-27.1	-26.9	-26.0	-25.7	-25.6
68.0	-25.1	-25.2	-25.6	-26.2	-27.0	-28.0	-29.3	-30.6	-31.7	-32.1	-31.7	-30.8	-29.7	-28.6	-27.8	-27.1	-26.6	-26.3	-26.3
70.0	-25.7	-25.8	-26.2	-26.8	-27.6	-28.7	-29.9	-31.2	-32.3	-32.8	-32.4	-31.5	-30.8	-29.5	-28.9	-27.8	-27.3	-27.1	-27.0

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 35.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
2.0	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
4.0	9.8	9.8	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.8
6.0	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
8.0	8.3	8.3	8.3	8.2	8.2	8.2	8.2	8.1	8.1	8.1	8.1	8.1	8.2	8.2	8.2	8.2	8.3	8.3	8.3
10.0	7.2	7.2	7.1	7.1	7.1	7.0	7.0	7.0	6.9	6.9	6.9	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.2
12.0	5.8	5.8	5.8	5.7	5.6	5.6	5.5	5.5	5.4	5.4	5.4	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8
14.0	4.2	4.2	4.1	4.0	3.9	3.8	3.8	3.7	3.6	3.6	3.6	3.7	3.8	3.8	3.9	4.0	4.1	4.1	4.1
16.0	2.3	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.5	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.2
18.0	.3	.2	.1	-.1	-.3	-.5	-.6	-.8	-.9	-.9	-.9	-.8	-.7	-.5	-.4	-.2	-.1	.0	.1
20.0	-1.8	-1.9	-2.1	-2.4	-2.7	-3.0	-3.2	-3.4	-3.6	-3.7	-3.6	-3.4	-3.3	-3.1	-2.9	-2.7	-2.5	-2.3	-2.3
22.0	-3.8	-4.0	-4.3	-4.8	-5.2	-5.6	-5.9	-6.2	-6.5	-6.6	-6.5	-6.3	-6.0	-5.7	-5.5	-5.2	-4.9	-4.7	-4.6
24.0	-5.5	-5.7	-6.2	-6.9	-7.4	-8.0	-8.5	-9.0	-9.4	-9.5	-9.4	-9.0	-8.6	-8.2	-7.9	-7.5	-7.1	-6.8	-6.7
26.0	-6.7	-6.9	-7.5	-8.3	-9.1	-9.9	-10.5	-11.2	-11.8	-12.1	-11.8	-11.2	-10.7	-10.2	-9.8	-9.3	-8.8	-8.4	-8.2
28.0	-7.6	-7.8	-8.4	-9.3	-10.3	-11.1	-11.9	-12.8	-13.6	-13.9	-13.6	-12.8	-12.1	-11.6	-11.1	-10.5	-9.9	-9.5	-9.3
30.0	-8.2	-8.5	-9.1	-10.0	-11.0	-11.9	-12.8	-13.8	-14.7	-15.1	-14.7	-13.8	-13.0	-12.4	-11.9	-11.3	-10.7	-10.2	-10.1
32.0	-8.9	-9.2	-9.6	-10.7	-11.7	-12.6	-13.6	-14.6	-15.6	-16.0	-15.5	-14.6	-13.8	-13.1	-12.6	-12.0	-11.4	-10.9	-10.8
34.0	-9.8	-10.0	-10.6	-11.4	-12.4	-13.4	-14.4	-15.4	-16.4	-16.8	-16.4	-15.5	-14.6	-13.9	-13.3	-12.7	-12.1	-11.7	-11.5
36.0	-10.8	-11.0	-11.5	-12.4	-13.3	-14.3	-15.3	-16.4	-17.4	-17.8	-17.4	-16.5	-15.5	-14.8	-14.2	-13.6	-13.0	-12.6	-12.5
38.0	-12.0	-12.1	-12.7	-13.5	-14.4	-15.4	-16.5	-17.6	-18.6	-19.0	-18.5	-17.6	-16.7	-15.9	-15.2	-14.6	-14.1	-13.7	-13.6
40.0	-13.1	-13.2	-13.7	-14.5	-15.4	-16.4	-17.5	-19.7	-19.7	-20.1	-19.6	-18.7	-17.7	-16.9	-16.2	-15.6	-15.1	-14.7	-14.6
42.0	-14.1	-14.3	-14.7	-15.4	-16.3	-17.4	-18.5	-19.7	-20.7	-21.1	-20.6	-19.7	-18.7	-17.8	-17.1	-16.5	-16.0	-15.6	-15.5
44.0	-15.0	-15.2	-15.6	-16.3	-17.2	-18.2	-19.4	-20.6	-21.6	-22.0	-21.6	-20.6	-19.6	-18.7	-17.9	-17.3	-16.8	-16.5	-16.4
46.0	-15.9	-16.0	-16.5	-17.1	-18.0	-19.1	-20.2	-21.4	-22.5	-22.9	-22.4	-21.5	-20.4	-19.5	-18.7	-18.1	-17.6	-17.3	-17.2
48.0	-16.7	-16.8	-17.2	-17.9	-18.8	-19.8	-21.0	-22.2	-23.2	-23.6	-23.2	-22.2	-21.2	-20.2	-19.4	-18.8	-18.3	-18.0	-17.9
50.0	-17.4	-17.6	-18.0	-18.6	-19.5	-20.5	-21.7	-22.9	-24.0	-24.4	-23.9	-23.0	-21.9	-20.9	-20.1	-19.5	-19.0	-18.7	-18.6
52.0	-18.1	-18.3	-18.7	-19.3	-20.2	-21.2	-22.4	-23.6	-24.7	-25.1	-24.6	-23.7	-22.6	-21.6	-20.8	-20.1	-19.7	-19.4	-19.3
54.0	-18.8	-18.9	-19.3	-19.9	-20.8	-21.8	-23.0	-24.3	-25.3	-25.7	-25.3	-24.3	-23.2	-22.2	-21.4	-20.8	-20.3	-20.0	-19.9
56.0	-19.4	-19.6	-19.9	-20.6	-21.4	-22.4	-23.6	-24.9	-26.0	-26.4	-25.9	-25.0	-23.9	-22.8	-22.0	-21.4	-20.9	-20.6	-20.5
58.0	-20.0	-20.2	-20.5	-21.1	-22.0	-23.0	-24.2	-25.5	-26.6	-27.0	-26.6	-25.6	-24.5	-23.4	-22.6	-21.9	-21.5	-21.2	-21.1
60.0	-20.6	-20.7	-21.1	-21.7	-22.6	-23.6	-24.8	-26.1	-27.1	-27.6	-27.1	-26.2	-25.1	-24.0	-23.2	-22.5	-22.0	-21.8	-21.7
62.0	-21.2	-21.3	-21.7	-22.3	-23.1	-24.2	-25.4	-26.7	-27.7	-28.2	-27.7	-26.8	-25.6	-24.6	-23.8	-23.1	-22.6	-22.3	-22.2
64.0	-21.8	-21.9	-22.2	-22.8	-23.7	-24.7	-25.9	-27.2	-28.3	-28.8	-28.3	-27.4	-26.2	-25.2	-24.4	-23.7	-23.2	-22.9	-22.8
66.0	-22.3	-22.5	-22.8	-23.4	-24.2	-25.3	-26.5	-27.8	-28.9	-29.4	-29.0	-28.0	-26.9	-25.8	-25.0	-24.3	-23.8	-23.6	-23.5
68.0	-22.9	-23.0	-23.4	-24.0	-24.8	-25.9	-27.1	-28.4	-29.5	-30.0	-29.6	-28.6	-27.5	-26.5	-25.6	-25.0	-24.5	-24.2	-24.1
70.0	-23.5	-23.6	-24.0	-24.6	-25.4	-26.5	-27.7	-29.0	-30.2	-30.6	-30.3	-29.3	-28.2	-27.2	-26.3	-25.7	-25.2	-24.9	-24.8

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 40.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG)																		
	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
2.0	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
4.0	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
6.0	9.0	9.0	9.0	9.0	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.0
8.0	8.2	8.2	8.2	8.1	8.1	8.1	8.1	8.0	8.0	8.0	8.0	8.0	8.1	8.1	8.1	8.1	8.1	8.2	8.2
10.0	7.1	7.1	7.1	7.1	7.0	7.0	6.9	6.9	6.9	6.9	6.9	6.9	6.9	7.0	7.0	7.0	7.1	7.1	7.1
12.0	5.9	5.9	5.8	5.7	5.7	5.6	5.6	5.5	5.5	5.5	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.8
14.0	4.4	4.3	4.3	4.2	4.1	4.0	3.9	3.8	3.8	3.8	3.8	3.8	3.9	4.0	4.1	4.1	4.2	4.3	4.3
16.0	2.7	2.6	2.5	2.4	2.2	2.1	2.0	1.9	1.8	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.5
18.0	.8	.7	.6	.4	.2	-.0	-.2	-.3	-.4	-.5	-.4	-.3	-.2	-.1	.1	.2	.4	.5	.5
20.0	-1.1	-1.2	-1.4	-1.8	-2.1	-2.3	-2.6	-2.8	-3.0	-3.0	-3.0	-2.8	-2.6	-2.4	-2.2	-2.0	-1.8	-1.7	-1.6
22.0	-2.9	-3.0	-3.4	-3.8	-4.3	-4.7	-5.0	-5.4	-5.6	-5.7	-5.6	-5.4	-5.1	-4.8	-4.6	-4.3	-4.0	-3.8	-3.7
24.0	-4.3	-4.5	-5.0	-5.6	-6.3	-6.8	-7.3	-7.8	-8.3	-8.4	-8.2	-7.8	-7.4	-7.1	-6.8	-6.4	-6.0	-5.6	-5.5
26.0	-5.3	-5.5	-6.1	-6.9	-7.8	-8.5	-9.2	-9.9	-10.5	-10.7	-10.5	-9.9	-9.3	-8.9	-8.4	-8.0	-7.4	-7.0	-6.9
28.0	-6.0	-6.3	-6.9	-7.8	-8.8	-9.6	-10.4	-11.3	-12.1	-12.4	-12.0	-11.3	-10.6	-10.1	-9.6	-9.0	-8.4	-8.0	-7.8
30.0	-6.6	-6.9	-7.5	-8.4	-9.4	-10.3	-11.2	-12.2	-13.1	-13.5	-13.1	-12.2	-11.4	-10.8	-10.3	-9.7	-9.1	-8.5	-8.5
32.0	-7.2	-7.5	-8.1	-9.0	-10.0	-11.0	-11.9	-12.9	-13.9	-14.3	-13.9	-12.9	-12.1	-11.5	-10.9	-10.3	-9.7	-9.2	-9.1
34.0	-8.0	-8.2	-8.8	-9.7	-10.7	-11.6	-12.6	-13.7	-14.6	-15.0	-14.6	-13.7	-12.8	-12.1	-11.5	-10.9	-10.4	-9.9	-9.7
36.0	-8.9	-9.1	-9.7	-10.5	-11.5	-12.5	-13.5	-14.5	-15.5	-15.9	-15.5	-14.6	-13.7	-12.9	-12.3	-11.7	-11.2	-10.7	-10.6
38.0	-10.0	-10.2	-10.7	-11.5	-12.5	-13.5	-14.5	-15.6	-16.6	-17.0	-16.6	-15.7	-14.7	-13.9	-13.3	-12.7	-12.1	-11.8	-11.6
40.0	-11.1	-11.3	-11.9	-12.6	-13.5	-14.5	-15.6	-16.7	-17.7	-18.1	-17.7	-16.8	-15.8	-15.0	-14.3	-13.7	-13.2	-12.8	-12.7
42.0	-12.1	-12.3	-12.8	-13.5	-14.4	-15.5	-16.6	-17.7	-18.7	-19.1	-18.7	-17.8	-16.8	-15.9	-15.2	-14.6	-14.1	-13.7	-13.6
44.0	-13.1	-13.2	-13.7	-14.4	-15.3	-16.3	-17.5	-18.7	-19.7	-20.1	-19.6	-18.7	-17.7	-16.8	-16.0	-15.4	-14.9	-14.6	-14.5
46.0	-14.0	-14.1	-14.6	-15.2	-16.1	-17.2	-18.3	-19.5	-20.5	-20.9	-20.5	-19.5	-18.5	-17.6	-16.8	-16.2	-15.7	-15.4	-15.3
48.0	-14.8	-14.9	-15.3	-16.0	-16.9	-17.9	-19.1	-20.3	-21.3	-21.7	-21.3	-20.3	-19.3	-18.3	-17.6	-16.9	-16.4	-16.1	-16.0
50.0	-15.5	-15.7	-16.1	-16.7	-17.6	-18.6	-19.8	-21.0	-22.1	-22.5	-22.0	-21.1	-20.0	-19.0	-18.3	-17.6	-17.1	-16.9	-16.7
52.0	-16.2	-16.4	-16.8	-17.4	-18.3	-19.3	-20.5	-21.7	-22.8	-23.2	-22.7	-21.8	-20.7	-19.7	-18.9	-18.3	-17.8	-17.5	-17.4
54.0	-16.9	-17.0	-17.4	-18.0	-18.9	-19.9	-21.1	-22.4	-23.4	-23.8	-23.4	-22.4	-21.3	-20.4	-19.5	-18.9	-18.4	-18.1	-18.0
56.0	-17.5	-17.7	-18.0	-18.7	-19.5	-20.5	-21.7	-23.0	-24.1	-24.5	-24.0	-23.1	-22.0	-21.0	-20.1	-19.5	-19.0	-18.7	-18.6
58.0	-18.1	-18.3	-18.6	-19.3	-20.1	-21.1	-22.3	-23.6	-24.7	-25.1	-24.7	-23.7	-22.6	-21.6	-20.7	-20.1	-19.6	-19.3	-19.2
60.0	-18.7	-18.6	-19.2	-19.8	-20.7	-21.7	-22.9	-24.2	-25.3	-25.7	-25.3	-24.3	-23.2	-22.2	-21.3	-20.7	-20.2	-19.9	-19.8
62.0	-19.3	-19.4	-19.8	-20.4	-21.2	-22.3	-23.5	-24.8	-25.8	-26.3	-25.9	-24.9	-23.8	-22.7	-21.9	-21.2	-20.8	-20.5	-20.4
64.0	-19.9	-20.0	-20.4	-21.0	-21.8	-22.8	-24.1	-25.3	-26.4	-26.9	-26.5	-25.5	-24.4	-23.3	-22.5	-21.8	-21.4	-21.1	-21.0
66.0	-20.4	-20.6	-20.9	-21.5	-22.4	-23.4	-24.6	-25.9	-27.0	-27.5	-27.1	-26.1	-25.0	-24.0	-23.1	-22.4	-22.0	-21.7	-21.6
68.0	-21.0	-21.2	-21.5	-22.1	-22.9	-24.0	-25.2	-26.5	-27.6	-28.1	-27.7	-26.7	-25.6	-24.6	-23.8	-23.1	-22.6	-22.3	-22.3
70.0	-21.6	-21.8	-22.1	-22.7	-23.6	-24.6	-25.9	-27.2	-28.3	-28.8	-28.4	-27.4	-26.3	-25.3	-24.5	-23.8	-23.3	-23.1	-23.0

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 45.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
2.0	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
4.0	9.4	9.4	9.4	9.4	9.4	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.4	9.4	9.4	9.4	9.4
6.0	8.8	8.8	8.8	8.6	8.8	8.8	8.8	8.8	8.8	8.7	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
8.0	8.1	8.1	8.1	8.0	8.0	8.0	8.0	7.9	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.0	8.0	8.1	8.1
10.0	7.1	7.1	7.1	7.0	7.0	6.9	6.9	6.9	6.8	6.8	6.8	6.9	6.9	6.9	7.0	7.0	7.0	7.1	7.1
12.0	5.9	5.9	5.5	5.6	5.7	5.6	5.6	5.5	5.5	5.5	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.8
14.0	4.5	4.5	4.4	4.3	4.2	4.1	4.0	4.0	3.9	3.9	3.9	4.0	4.0	4.1	4.2	4.3	4.3	4.4	4.4
16.0	2.9	2.9	2.8	2.6	2.5	2.3	2.2	2.1	2.0	2.0	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.7
18.0	1.3	1.2	1.0	.8	.5	.3	.2	.0	-.1	-.1	-.1	.0	.2	.3	.4	.6	.7	.9	.9
20.0	-.4	-.5	-.8	-1.2	-1.5	-1.8	-2.0	-2.3	-2.4	-2.5	-2.4	-2.3	-2.1	-1.9	-1.7	-1.5	-1.3	-1.1	-1.0
22.0	-2.0	-2.1	-2.5	-3.0	-3.5	-3.9	-4.3	-4.6	-4.9	-5.0	-4.9	-4.6	-4.4	-4.1	-3.8	-3.5	-3.2	-3.0	-2.9
24.0	-3.2	-3.4	-3.9	-4.6	-5.3	-5.9	-6.4	-6.9	-7.3	-7.5	-7.3	-6.9	-6.5	-6.1	-5.8	-5.4	-5.0	-4.6	-4.5
26.0	-4.1	-4.3	-4.9	-5.7	-6.6	-7.3	-8.0	-8.7	-9.3	-9.6	-9.3	-8.7	-8.1	-7.7	-7.3	-6.8	-6.3	-5.8	-5.7
28.0	-4.7	-4.9	-5.6	-6.5	-7.4	-8.3	-9.1	-9.9	-10.7	-11.1	-10.7	-10.0	-9.3	-8.7	-8.3	-7.7	-7.1	-6.7	-6.5
30.0	-5.2	-5.4	-6.1	-7.0	-8.0	-8.9	-9.8	-10.8	-11.7	-12.1	-11.7	-10.8	-10.0	-9.4	-8.9	-8.3	-7.7	-7.2	-7.1
32.0	-5.7	-6.0	-6.6	-7.6	-8.5	-9.5	-10.4	-11.4	-12.4	-12.8	-12.3	-11.5	-10.6	-10.0	-9.4	-8.9	-8.2	-7.8	-7.6
34.0	-6.4	-6.6	-7.3	-8.2	-9.1	-10.1	-11.1	-12.1	-13.1	-13.5	-13.0	-12.1	-11.3	-10.6	-10.0	-9.4	-8.8	-8.4	-8.2
36.0	-7.2	-7.4	-8.0	-8.9	-9.9	-10.8	-11.8	-12.9	-13.9	-14.3	-13.9	-12.9	-12.0	-11.3	-10.7	-10.1	-9.6	-9.1	-9.0
38.0	-8.2	-8.4	-9.0	-9.8	-10.8	-11.8	-12.8	-13.9	-14.9	-15.3	-14.9	-13.9	-13.0	-12.3	-11.6	-11.0	-10.5	-10.1	-9.9
40.0	-9.4	-9.6	-10.1	-10.9	-11.8	-12.8	-13.9	-15.0	-16.0	-16.4	-16.0	-15.0	-14.1	-13.3	-12.6	-12.0	-11.5	-11.1	-11.0
42.0	-10.4	-10.6	-11.1	-11.8	-12.7	-13.8	-14.9	-16.0	-17.0	-17.4	-17.0	-16.1	-15.1	-14.2	-13.5	-12.9	-12.4	-12.0	-11.9
44.0	-11.4	-11.5	-12.0	-12.7	-13.6	-14.6	-15.8	-17.0	-18.0	-18.4	-17.9	-17.0	-16.0	-15.1	-14.4	-13.7	-13.2	-12.9	-12.8
46.0	-12.3	-12.4	-12.9	-13.6	14.4	-15.5	-16.6	-17.8	-18.8	-19.2	-18.8	-17.8	-16.8	-15.9	-15.2	-14.5	-14.0	-13.7	-13.6
48.0	-13.1	-13.2	-13.6	-14.3	-15.2	-16.2	-17.4	-18.6	-19.6	-20.0	-19.6	-18.6	-17.6	-16.7	-15.9	-15.3	-14.8	-14.5	-14.4
50.0	-13.8	-14.0	-14.4	-15.0	-15.9	-17.0	-18.1	-19.4	-20.4	-20.8	-20.4	-19.4	-18.3	-17.4	-16.6	-16.0	-15.5	-15.2	-15.1
52.0	-14.5	-14.7	-15.1	-15.7	-16.6	-17.6	-18.8	-20.1	-21.1	-21.5	-21.1	-20.1	-19.0	-18.1	-17.2	-16.6	-16.1	-15.8	-15.7
54.0	-15.2	-15.3	-15.7	-16.4	-17.2	-18.3	-19.5	-20.7	-21.8	-22.2	-21.7	-20.8	-19.7	-18.7	-17.9	-17.2	-16.8	-16.5	-16.4
56.0	-15.8	-16.0	-16.4	-17.0	-17.8	-18.9	-20.1	-21.3	-22.4	-22.8	-22.4	-21.4	-20.3	-19.3	-18.5	-17.8	-17.4	-17.1	-17.0
58.0	-16.5	-16.6	-17.0	-17.6	-18.4	-19.5	-20.7	-21.9	-23.0	-23.4	-23.0	-22.0	-20.9	-19.9	-19.1	-18.4	-17.9	-17.7	-17.6
60.0	-17.0	-17.2	-17.5	-18.2	-19.0	-20.0	-21.3	-22.5	-23.6	-24.0	-23.6	-22.6	-21.5	-20.5	-19.7	-19.0	-18.5	-18.2	-18.1
62.0	-17.6	-17.7	-18.1	-18.7	-19.6	-20.6	-21.8	-23.1	-24.2	-24.6	-24.2	-23.2	-22.1	-21.1	-20.2	-19.6	-19.1	-18.8	-18.7
64.0	-18.2	-18.3	-18.7	-19.3	-20.1	-21.2	-22.4	-23.7	-24.8	-25.2	-24.8	-23.8	-22.7	-21.7	-20.8	-20.2	-19.7	-19.4	-19.3
66.0	-18.8	-18.9	-19.3	-19.9	-20.7	-21.7	-23.0	-24.3	-25.4	-25.8	-25.4	-24.4	-23.3	-22.3	-21.5	-20.8	-20.3	-20.1	-20.0
68.0	-19.4	-19.5	-19.9	-20.5	-21.3	-22.3	-23.6	-24.9	-26.0	-26.4	-26.1	-25.1	-24.0	-23.0	-22.1	-21.5	-21.0	-20.7	-20.6
70.0	-20.0	-20.1	-20.5	-21.1	-21.9	-23.0	-24.2	-25.5	-26.6	-27.1	-26.7	-25.8	-24.7	-23.7	-22.8	-22.2	-21.7	-21.4	-21.3

NRCS TABLE IN DECIBELS

FREQUENCY = 13.9 GHZ
VERTICAL POLARIZATION
FRICTION VELOCITY = 50.0 CM/SEC

INCIDENCE ANGLE (DEG)	RELATIVE AZIMUTH ANGLE (DEG) 0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0
0.0	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
2.0	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
4.0	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
6.0	8.7	8.7	8.7	8.7	8.7	8.7	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.7	8.7	8.7	8.7	8.7	8.7
8.0	8.0	8.0	8.0	7.9	7.9	7.9	7.9	7.8	7.8	7.8	7.8	7.8	7.9	7.9	7.9	7.9	7.9	8.0	8.0
10.0	7.1	7.1	7.0	7.0	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.8	6.9	6.9	6.9	7.0	7.0	7.0	7.0
12.0	6.0	5.9	5.9	5.8	5.7	5.7	5.6	5.6	5.5	5.5	5.5	5.6	5.6	5.7	5.7	5.8	5.8	5.9	5.9
14.0	4.7	4.6	4.5	4.4	4.3	4.2	4.1	4.1	4.0	4.0	4.0	4.1	4.1	4.2	4.3	4.4	4.4	4.5	4.5
16.0	3.2	3.1	3.0	2.8	2.7	2.5	2.4	2.3	2.2	2.2	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
18.0	1.7	1.6	1.4	1.1	.9	.7	.5	.3	.2	.2	.2	.3	.5	.6	.8	.9	1.1	1.2	1.3
20.0	.2	.0	-.3	-.6	-1.0	-1.3	-1.6	-1.8	-2.0	-2.1	-2.0	-1.8	-1.6	-1.4	-1.2	-1.0	-.8	-.6	-.5
22.0	-1.2	-1.3	-1.8	-2.3	-2.8	-3.3	-3.6	-4.0	-4.3	-4.4	-4.3	[illegible]	-3.7	-3.4	-3.2	-2.9	-2.5	-2.3	-2.2
24.0	-2.2	-2.4	-3.0	-3.7	-4.4	-5.0	-5.5	-6.0	-6.5	-6.7	-6.5	-6.0	-5.6	-5.2	-4.9	-4.5	-4.1	-3.7	-3.6
26.0	-3.0	-3.2	-3.8	-4.7	-5.5	-6.3	-6.9	-7.6	-8.3	-8.6	-8.3	-7.7	-7.1	-6.6	-6.2	-5.7	-5.2	-4.8	-4.6
28.0	-3.5	-3.7	-4.4	-5.3	-6.3	-7.1	-7.9	-8.8	-9.6	-9.9	-9.6	[illegible]	-8.1	-7.6	-7.1	-6.6	-6.0	-5.5	-5.3
30.0	-3.9	-4.2	-4.9	-5.8	-6.8	-7.7	-8.6	-9.5	-10.4	-10.8	-10.4	-9.5	-8.8	-8.2	-7.7	-7.1	-6.5	-6.0	-5.8
32.0	-4.4	-4.7	-5.3	-6.3	-7.3	-8.2	-9.1	-10.1	-11.1	-11.5	-11.0	-10.1	-9.3	-8.7	-8.2	-7.6	-7.0	-6.5	-6.3
34.0	-5.0	-5.3	-5.9	-6.8	-7.8	-8.7	-9.7	-10.7	-11.7	-12.1	-11.7	-10.8	-9.9	-9.2	-8.7	-8.1	-7.5	-7.0	-6.8
36.0	-5.8	-6.0	-6.6	-7.5	-8.4	-9.4	-10.4	-11.5	-12.4	-12.9	-12.4	-11.5	-10.6	-9.9	-9.3	-8.7	-8.1	-7.7	-7.5
38.0	-6.7	-6.9	-7.5	-8.3	-9.3	-10.3	-11.3	-12.4	-13.4	-13.8	-13.3	-12.4	-11.5	-10.8	-10.1	-9.5	-9.0	-8.6	-8.4
40.0	-7.8	-8.0	-8.6	-9.3	-10.3	-11.3	-12.4	-13.5	-14.5	-14.9	-14.4	-13.5	-12.6	-11.8	-11.1	-10.5	-10.0	-9.6	-9.4
42.0	-8.9	-9.1	-9.6	-10.3	-11.2	-12.3	-13.3	-14.5	-15.5	-15.9	-15.5	-14.5	-13.5	-12.7	-12.0	-11.4	-10.9	-10.5	-10.4
44.0	-9.8	-10.0	-10.5	-11.2	-12.1	-13.1	-14.3	-15.4	-16.4	-16.8	-16.4	-15.5	-14.5	-13.6	-12.9	-12.3	-11.7	-11.4	-11.3
46.0	-10.7	-10.9	-11.3	-12.0	-12.9	-14.0	-15.1	-16.3	-17.3	-17.7	-17.3	-16.3	-15.3	-14.4	-13.7	-13.0	-12.5	-12.2	-12.1
48.0	-11.5	-11.7	-12.1	-12.8	-13.7	-14.7	-15.9	-17.1	-19.1	-18.5	-18.1	-17.1	-16.1	-15.2	-14.4	-13.8	-13.3	-13.0	-12.9
50.0	-12.3	-12.5	-12.9	-13.5	-14.4	-15.5	-16.6	-17.9	-18.9	-19.3	-18.8	-17.9	-16.8	-15.9	-15.1	-14.5	-14.0	-13.7	-13.6
52.0	-13.0	-13.2	-13.6	-14.2	-15.1	-16.1	-17.3	-18.6	-19.6	-20.0	-19.6	-18.6	-17.5	-16.6	-15.8	-15.1	-14.6	-14.3	-14.2
54.0	-13.7	-13.8	-14.2	-14.9	-15.7	-16.8	-18.0	-19.2	-20.3	-20.7	-20.2	-19.3	-18.2	-17.2	-16.4	-15.7	-15.3	-15.0	-14.9
56.0	-14.3	-14.5	-14.9	-15.5	-16.3	-17.4	-18.6	-19.9	-20.9	-21.3	-20.9	-19.9	-18.8	-17.8	-17.0	-16.4	-15.9	-15.6	-15.5
58.0	-15.0	-15.1	-15.5	-16.1	-16.9	-18.0	-19.2	-20.5	-21.5	-21.9	[illegible]	-20.5	-19.4	-18.4	-17.6	-16.9	-16.5	-16.2	-16.1
60.0	-15.5	-15.7	-16.1	-16.7	-17.5	-18.6	-19.8	-21.0	-22.1	-22.5	-22.1	-21.1	-20.0	-19.0	-18.2	-17.5	-17.1	-16.8	-16.7
62.0	-16.1	-16.3	-16.6	-17.2	-18.1	-19.1	-20.3	-21.6	-22.7	-23.1	-22.7	-21.7	-20.6	-19.6	-18.8	-18.1	-17.6	-17.4	-17.3
64.0	-16.7	-16.8	-17.2	-17.8	-18.6	-19.7	-20.9	-22.2	-23.3	-23.7	-23.3	-22.3	-21.2	-20.2	-19.4	-18.7	-18.2	-18.0	-17.9
66.0	-17.3	-17.4	-17.8	-18.4	-19.2	-20.3	-21.5	-22.8	-23.9	-24.3	-23.9	-23.0	-21.9	-20.8	-20.0	-19.3	-18.9	-18.6	-18.5
68.0	-17.9	-18.0	-18.4	-19.0	-19.8	-20.9	-22.1	-23.4	-24.5	-25.0	-24.6	-23.6	-22.5	-21.5	-20.6	-20.0	-19.5	-19.2	-19.2
70.0	-18.5	-18.6	-19.0	-19.6	-20.4	-21.5	-22.7	-24.0	-25.1	-25.6	-25.3	-24.3	-23.2	-22.2	-21.4	-20.7	-20.2	-20.0	-19.9

APPENDIX C

LIST OF SYMBOLS AND ABBREVIATIONS

a_0	first regression parameter for zeroth-order harmonic A_m
a_1	second regression parameter for zeroth-order harmonic A_m
A_m	zeroth-order harmonic of the capillary wavenumber spectrum at the point of minimum phase speed, in cm^4
A_r	ratio of the first-order to the zeroth-order harmonic of the capillary wavenumber spectrum
AAFE	Advance Application Flight Experiment
B	capillary wave straining coefficient
C_{IJ}	covariance between Ith and Jth generalized parameters
$d\vec{n}$	differential solid angle in $\vec{n}$ space
$dS_u dS_c$	differential area in surface-slope space
dx	differential in generalized parameter space
$\vec{e}_h$	regional horizontal polarization unit vector
$\vec{e}_v$	regional vertical polarization unit vector
$\vec{E}_i$	incident polarization unit vector
$\vec{F}_s$	scattered polarization unit vector
$f(\cdots)$	NRCS function, in decibels
$f_{ij}(\cdots)$	NRCS function, in logarithm
$F(\cdots)$	regional capillary wavenumber spectrum, in cm^4
$g(\cdots)$	probability exponent
$G(\cdots)$	Bragg scattering intergrand
i	index denoting wind-sea state
I	first index denoting generalized parameter
j	index denoting NRCS measurement

J	second index denoting generalized parameter
JONSWAP	Joint North Atlantic Sea Wave Project
k	radiation wavenumber, in cm^{-1}
$\vec{k}_i$	incident propagation unit vector
$\vec{k}_s$	scattered propagation unit vector
ℓ	summation index for steepest descent calculation
m	total number of generalized parameters
n	total number of generalized measurements
$\vec{n}$	regional surface-normal unit vector
$\vec{n}(\cdots)$	regional surface-normal unit vector function
$\vec{N}$	unit normal to mean sea surface subtended by the radar footprint
NRCS	normalized radar cross section
p	NRCS model parameter
$P(\cdots)$	generalized probability density function
$P_n(\cdots)$	probability density function for the regional surface normal $\vec{n}$
$P_s(\cdots)$	probability density function for the regional surface slopes
pdf	probability density function
q	power law for capillary wavenumber spectrum
R	power reflection coefficient, equals $S_g(\cdots)$
rms	root mean squared
s_0	first regression parameter for total rms slope $\bar{S}$
s_1	second regression parameter for total rms slope $\bar{S}$
$\bar{S}$	total rms regional slope
$S_b(\cdots)$	Bragg scattering function
S_c	crosswind regional surface slope
$\bar{S}_c$	rms crosswind regional surface slope
S_c^{ℓ}	crosswind surface slopes for steepest descent calculation

$S_g(\cdots)$	geometric-optics scattering function
S_u	upwind regional surface slope
$\bar{S}_u$	rms upwind regional surface slope
S_u^ℓ	upwind surface slopes for steepest descent calculation
sd	standard deviation
t	Bragg scattering breakdown parameter
$u(\cdots)$	unit step function
U	actual friction velocity, in logarithm of cm/sec
$\bar{U}$	measured friction velocity, in logarithm of cm/sec
U_*	friction velocity, magnitude of $\vec{U}_*$, in cm/sec
$\vec{U}_*$	friction velocity vector pointing upwind, in cm/sec
x	generalized parameter
y	generalized measurement
α_{hh}^b	horizontal polarization Bragg backscatter matrix element
α_{vv}^b	vertical polarization Bragg backscatter matrix element
β	first spline parameter
ΔU	standard deviation in friction velocity measurement, in logarithm of cm/sec
$\Delta\sigma$	standard deviation in the NRCS, in logarithm
$\Delta\chi$	standard deviation in wind direction measurement, in degrees
ε	relative permittivity of the air-sea interface
η	number of NRCS measurements
θ_b	incidence angle for Bragg scattering breakdown
θ_i	incidence angle
Θ_i	regional incidence angle
ι	index denoting generalized measurement
κ	capillary wavenumber, magnitude of $\vec{\kappa}$, in cm^{-1}

$\vec{\kappa}$	capillary vector wavenumber, in cm^{-1}
κ_b	Bragg wavenumber, magnitude of $\vec{\kappa}_b$, in cm^{-1}
$\vec{\kappa}_b$	Bragg vector wavenumber, in cm^{-1}
κ_m	capillary wavenumber corresponding to minimum phase speed, $\sim 3.63\ cm^{-1}$
μ	number of NRCS model parameters
ν	number of wind-sea states
ξ_i	number of NRCS measurements for ith wind-sea state
π	$3.14 \cdots$
ρ	ratio of the rms crosswind to upwind surface slopes
σ	actual normalized radar cross section, in logarithm
$\bar{\sigma}$	measured normalized radar cross section, in logarithm
$\sigma^\circ(\cdots)$	total normalized radar cross section, in ratio
$\sigma^\circ_b(\cdots)$	Bragg normalized radar cross section, in ratio
$\sigma^\circ_g(\cdots)$	geometric-optics normalized radar cross section, in ratio
τ	second spline parameter
ϕ_r	relative azimuth angle
χ	actual wind direction, in degrees
$\bar{\chi}$	measured wind direction, in degrees
ψ	polar angle for capillary wavenumber spectrum

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