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ANALYSIS OF WIND BIAS CHANGE WITH RESPECT TO TIME AT CAPE KENNEDY, FLORIDA, AND VANDENBERG AFB, CALIFORNIA

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16. ABSTRACT

This report presents a statistical analysis of the temporal variability of wind vectors at 1 km altitude intervals from 0 to 27 km altitude after applying a digital filter to the original wind profile data sample.

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I. INTRODUCTION

A typical wind model used for ascent vehicle wind biasing consists of the monthly mean wind at each altitude. Such a model does not contain the small scale perturbations normally found in Rawinsonde profiles. The smoothness of the wind profile model is not considered to be a serious deficiency because wind biasing is with respect to the predominant large scale perturbation in the profile. Thus, even if a single Rawinsonde profile obtained a few hours prior to launch is used as the basis for wind biasing, the small scale perturbations in the profile would be removed before implementation. Nevertheless, filtered profiles can still differ greatly from the monthly mean profile; therefore, individual filtered wind profiles that are representative of the wind conditions associated with a particular launch would be the most desirable basis for wind biasing of launch vehicles. The monthly mean wind profile is almost never representative of launch conditions.

The development of a pre-launch wind monitoring scheme to provide data for wind biasing will require knowledge of the change of smoothed wind profiles with respect to time. This report describes wind bias change with respect to time that has been calculated from the VAFB (1965-74) and KSC (1956-70) twice daily Rawinsonde series. Each profile in the series was filtered before calculation of wind change statistics. The filtering process removed the small scale perturbations. Wind change at KSC and VAFB for unfiltered profiles has been described in previous reports [1,2]. The methodology used in this study is basically the same; wind bias change for time intervals from 0 to 72 hours at altitudes from 5 to 22 km is calculated for selected months. Wind bias change is presented in terms of statistical summaries of wind bias component change and the modulus of vector wind bias change; the parameters of theoretical probability distribution functions representing the wind bias change variables are also presented. The validity of the theoretical distributions is established by comparing them with the observed distributions. These distribution functions can be utilized to obtain statistical predictions of wind change with respect to time.

This report consists of a brief statement of technical background (Section II), an analysis of wind change statistics calculated from filtered data (Section III) and conclusions (Section IV); the calculated statistics of wind bias change with respect to time for selected months 1 km altitude increments from 5 to 22 km to KSC and VAFB are listed in the appendix.

II. TECHNICAL BACKGROUND

A. INTRODUCTION

The large sample of wind profiles obtained at VAFB is suitable for calculation of an equally large sample of wind bias change data. In order to readily abstract information on wind bias change from these data, it is necessary to perform a second series of calculations which provide statistical summaries of wind bias change. The choice of statistical parameters for description of wind bias change is based in part on the need to specify the parameters of theoretical distributions of wind change. These theoretical distribution functions are described in detail by Smith [3]. The basic distribution of the four variables consisting of the zonal and meridional components of the wind bias vector at an initial time and after an elapsed time, Δt, is quadravariate normal. The conditional distribution of the wind bias components at a specified future time, given the wind bias components at an initial time, is bivariate normal. The modulus of the wind bias change vector is Rayleigh and the distribution of either the zonal or meridional wind bias component change is univariate normal. A significant portion of the analytical discussion in Section III of this report is the presentation of observed distributions of wind bias change and comparison with the theoretical distributions of wind bias change variables. Succeeding paragraphs of this section are concerned with a description of the wind bias profile data, the filtering of the data and the definition of statistical parameters of wind bias change used in the various theoretical distribution functions.

B. DATA

The basic winds aloft data are recorded in terms of wind direction, θ and magnitude, W. The wind vector is expressed in the standard meteorological coordinate system in which the direction from which the wind is blowing is measured in degrees clockwise from true north. The zonal component, u, of wind vector is positive for a west (west to east) wind ($\theta=270^0$) and negative for an east (east to west) wind ($\theta=90^0$); the meridional component, v, is positive for a south (south to north) wind ($\theta=180^0$) and negative for a north (north to south) wind ($\theta=0^0$); u and v are obtained from θ and W according to:

$$u = -W \sin \theta, \qquad 0 \leq \theta \leq 360^0 \qquad (1)$$

$$v = -W \cos \theta, \qquad (2)$$

The relation between θ defined above and the angle defined in standard mathematical polar fo s:

$$\theta = 270 - \theta_{Math} \qquad (3)$$

C. DIGITAL FILTER

Wind profiles suitable for wind biasing of launch vehicles (defined here as wind bias profiles) are calculated by application of an 11-point symmetrical Martin-Graham digital low-pass filter to Rawinsonde profiles. The filter removes the small scale pcrturbations in the wind profile without the addition of phase shift to the data. The filter gain and weighting functions are listed in Table 1. The effect of the filter on a particular profile is illustrated in Figure 1. Application of the filter to a wind profile originally containing data at 1 km intervals from 0 to 27 km produces a somewhat abbreviated filtered profile extending from 5 to 22 km. The mathematical background and computer code for calculation of the filter gain and weighting functions are described by Demandel and Krivo (4).

The typically large deviation of individual filtered and unfiltered Rawinsonde profiles from the artificial profile composed of the monthly mean at each altitude is also illustrated in Figure 1.

D. DEFINITIONS

The subscript 0 is used to denote the initial value of a variable, and the subscript 1 denotes the variable after an elapsed time, Δt. Thus:

$$\Delta u = u_1 - u_0 \qquad (4)$$

$$\Delta v = u_1 - v_0 \qquad (5)$$

Where Δu and Δv are the components of the wind bias change for a specified Δt. The modulus, R, of the wind bias change with respect to time is given by:

$$R = \sqrt{(\Delta u)^2 + (\Delta v)^2} \qquad (6)$$

Table 1. Filter Weights and Effective Response Function of an 11-Point Martin Graham Low Pass Filter with a Nominal Cutoff Frequency of .04 km^{-1} and a Termination Frequency of .20 km^{-1}

Filter Weights, h_i	
h_0	.22658165
$h_{+1,-1}$	.20033538
$h_{+2,-2}$	.13609867
$h_{+3,-3}$	.06181594
$h_{+4,-4}$	.00628003
$h_{+5,-5}$	.01832084

Response Function, G(f)	
$f(km^{-1})$	G(f)
.01	.996
.02	.985
.03	.966
.04	.940
.05	.905
.06	.863
.07	.813
.08	.756
.09	.693
.10	.624
.15	.251
.20	-.002
.30	.023
.40	-.023
.50	.023
.60	-.023
.70	.023
.80	-.023

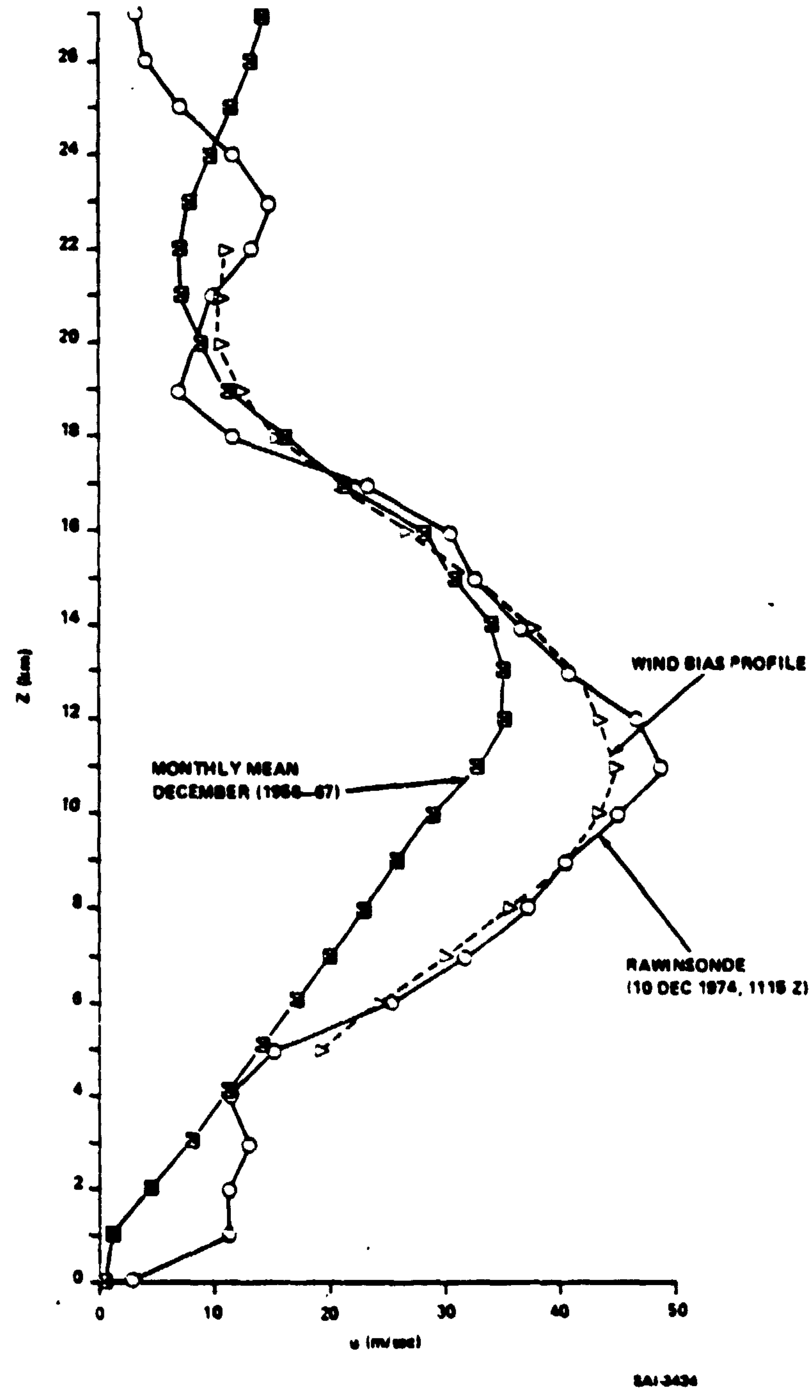

Figure 1. Wind Bias Profile Calculated from a Rawinsonde Profile and an Artificial Profile Composed of Monthly Means for the Period 1956-67 at KSC

The statistical means are denoted by an overbar, the standard deviations and the correlation coefficients are denoted by σ_X and R(X, Y), respectively, with X and Y replaced with the notation appropriate to the variable of interest.

E. STATISTICS

The wind vector measurements at an initial time and after an elapsed time are treated in this investigation as a sample from a quadravariate normal distribution defined by the fourteen statistics listed below:

<u>MEANS</u>

$$\overline{u}_0, \overline{v}_0, \overline{u}_1, \overline{v}_1$$

<u>STANDARD DEVIATIONS</u>

$$\sigma_{u_0}, \sigma_{v_0}, \sigma_{u_1}, \sigma_{v_1}$$

<u>CORRELATION COEFFICIENTS</u>

$$R(u_0, v_0), R(u_0, u_1)$$

$$R(v_0, v_1), R(u_1, v_1)$$

$$R(u_1, v_0), R(v_1, u_0)$$

The fourteen statistics of the quadravariate normal distribution of vector wind difference with respect to time consist of the five bivariate normal statistics of vector wind at an initial time ($\overline{u}_0$, $\overline{v}_0$, σ_{u_0}, σ_{v_0} and $R(u_0, v_0)$) and the nine statistics involving component differences which can be calculated from the quadravariate statistics listed above according to the following equations:

<u>MEANS</u>

$$\overline{\Delta u} = \overline{u_1 - u_0} = \overline{u_1} - \overline{u_0} \quad (7)$$

$$\overline{\Delta v} = \overline{v_1 - v_0} = \overline{v_1} - \overline{v_0} \quad (8)$$

STANDARD DEVIATIONS

$$\sigma_{\Delta u} = \sqrt{\sigma_{u_1}^{2} + \sigma_{u_0}^{2} - 2\sigma_{u_1}\sigma_{u_0} R(u_1, u_0)} \tag{9}$$

$$\sigma_{\Delta v} = \sqrt{\sigma_{v_1}^{2} + \sigma_{v_0}^{2} - 2\sigma_{v_1}\sigma_{v_0} R(v_1, v_0)} \tag{10}$$

Where R(x,y) is the correlation coefficient of variables x and y.

CORRELATION COEFFICIENTS

$$R(u_0, \Delta u) = \frac{\sigma_{u_1} R(u_0, u_1) - \sigma_{u_0}}{\sigma_{\Delta u}} \tag{11}$$

Where, $\sigma_{\Delta u}$ is obtained from Equation 9

$$R(v_0, \Delta v) = \frac{\sigma_{v_1} R(v_0, v_1) - \sigma_{v_0}}{\sigma_{\Delta v}} \tag{12}$$

Where, $\sigma_{\Delta v}$ is obtained from Equation 10

$$R(\Delta u, v_0) = \frac{\sigma_{u_1} R(v_0, u_1) - \sigma_{u_0} R(u_0, v_0)}{\sigma_{\Delta u}} \tag{13}$$

$$R(\Delta v, u_0) = \frac{\sigma_{v_1} R(u_0, v_1) - \sigma_{v_0} R(u_0, v_0)}{\sigma_{\Delta v}} \tag{14}$$

$$R(\Delta u, \Delta v) = \frac{[\sigma_{u_1}\sigma_{v_1} R(u_1, v_1) - \sigma_{u_1}\sigma_{v_0} R(u_1, v_0) + \sigma_{u_0}\sigma_{v_1} R(u_0, v_1) + \sigma_{u_0}\sigma_{v_0} R(u_0, v_0)]}{\sigma_{\Delta u}\ \sigma_{\Delta v}} \tag{15}$$

III. ANALYSIS

A. INTRODUCTION

The analysis of wind bias profile change with respect to time follows the approach taken in previous studys of vector wind change at KSC and VAFB [1,2]. The vectors under consideration have been modified by the filtering process described in the previous section. Since the component of wind change associated with small scale perturbations in the profile has been removed, the calculated wind change is expected to be smaller for wind bias profiles. The objective of this analysis is the establishment of a theoretical basis for estimation of wind bias change. This is accomplished by comparison of theoretical probability distributions which contain wind bias change sample statistics as parameters (from the appendix of this report), to observed probability distributions of wind bias change. Wind bias change with respect to time is analyzed herein in terms of wind component change, unconditional and conditional joint distributions of wind component change, and the modulus of vector wind change.

B. WIND BIAS COMPONENT CHANGE WITH RESPECT TO TIME

The theoretical probability distribution of wind component change with respect to time is univariate normal with zero mean and standard deviation given by Equations 9 and 10; the assumption of zero means of component differences is varified by the sample statistics given in the appendix. The theoretical normal distribution of component differences can be derived by using either the standard deviations of component differences given in the appendix or an estimate which can be obtained from the standard deviation of the components if it is assumed that:

$$\sigma_{u_0} = \sigma_{u_1} = \sigma_u$$

$$\sigma_{v_0} = \sigma_{v_1} = \sigma_v$$

Equations 9 and 10 reduce to

$$\sigma_{\Delta u} = \sqrt{2} \quad \sigma_u \sqrt{1 - R(u_1, u_0)} \tag{16}$$

$$\sigma_{\Delta v} = \sqrt{2} \quad \sigma_v \sqrt{1 - R(v_1, v_0)} \tag{17}$$

The wind component autocorrelation functions, $R(u_1, u_0)$ and $R(v_1, v_0)$ can be represented by a negative exponential function of time increment, τ; i.e.,

$$R(u_1, u_0) = \text{EXP } (-b\tau) \tag{18}$$

$$R(v_1, v_0) = \text{EXP } (-c\tau) \tag{19}$$

where b and c are computed according to

$$b = - \frac{\sum_i \tau_i \ln R_i(u_1, u_0)}{\sum_i \tau_i^2} \tag{20}$$

$$c = - \frac{\sum_i \tau_i \ln R_i(v_1, v_0)}{\sum_i \tau_i^2} \tag{21}$$

Examples of the decay of the autocorrelation function at 6, 12 and 18 km during April at Cape Kennedy and January at VAFB are illustrated in Figures 2 and 3, respectively; the lines in the figure represent the decay rate predicted by Equations 18 and 19.

Substitution of Equations 18 and 19 into 16 and 17, respectively, yields a simple expression for $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ in terms of σ_u and σ_v, respectively.

$$\sigma_{\Delta u} = \sqrt{2} \quad \sigma_u \sqrt{1 - \text{EXP } (-b\tau)} \tag{22}$$

$$\sigma_{\Delta v} = \sqrt{2} \quad \sigma_v \sqrt{1 - \text{EXP } (-c\tau)} \tag{23}$$

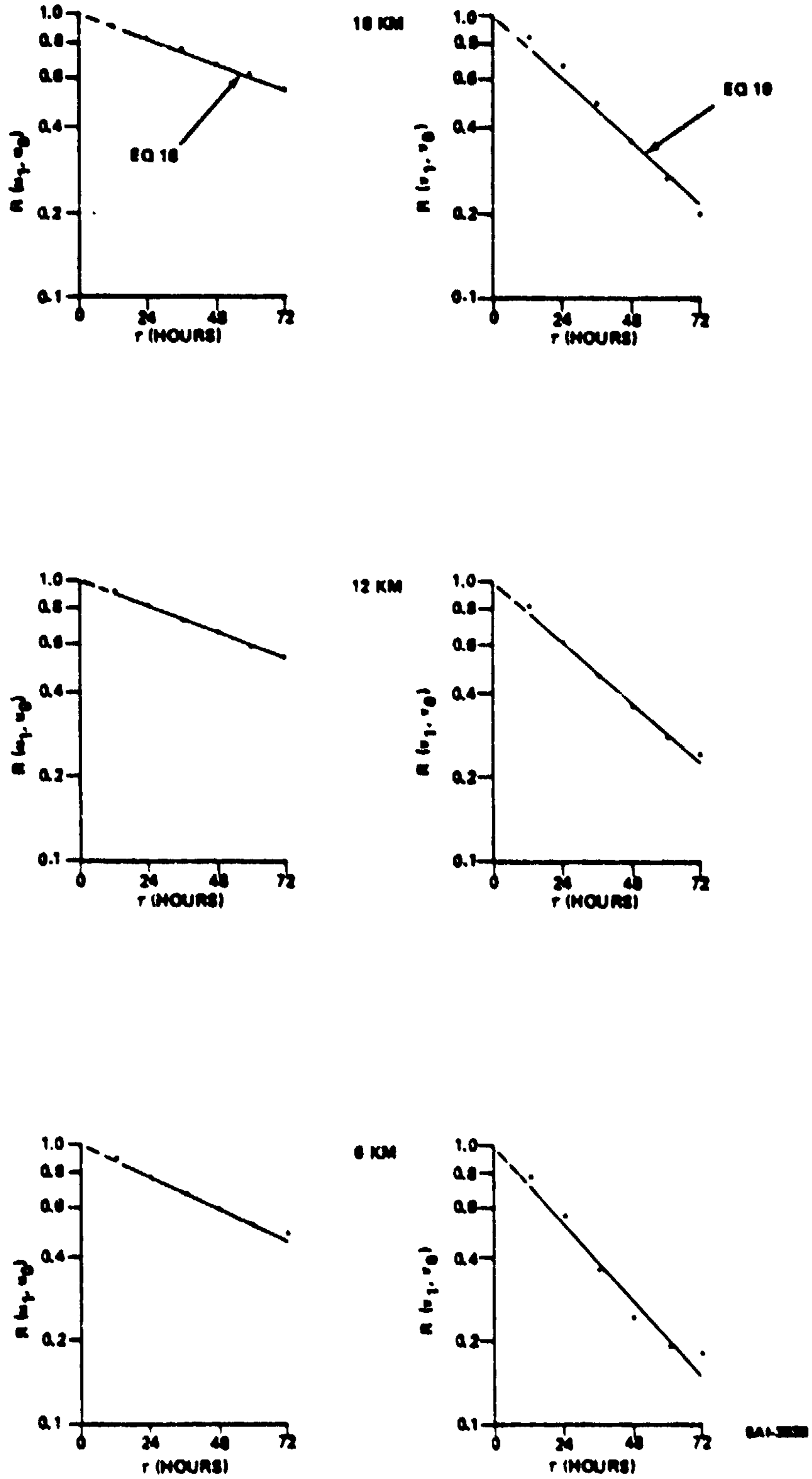

Figure 2. Zonal and Meridional Wind Bias Component Autocorrelation During April at 6, 12, and 18 km at Cape Kennedy (1956-70)

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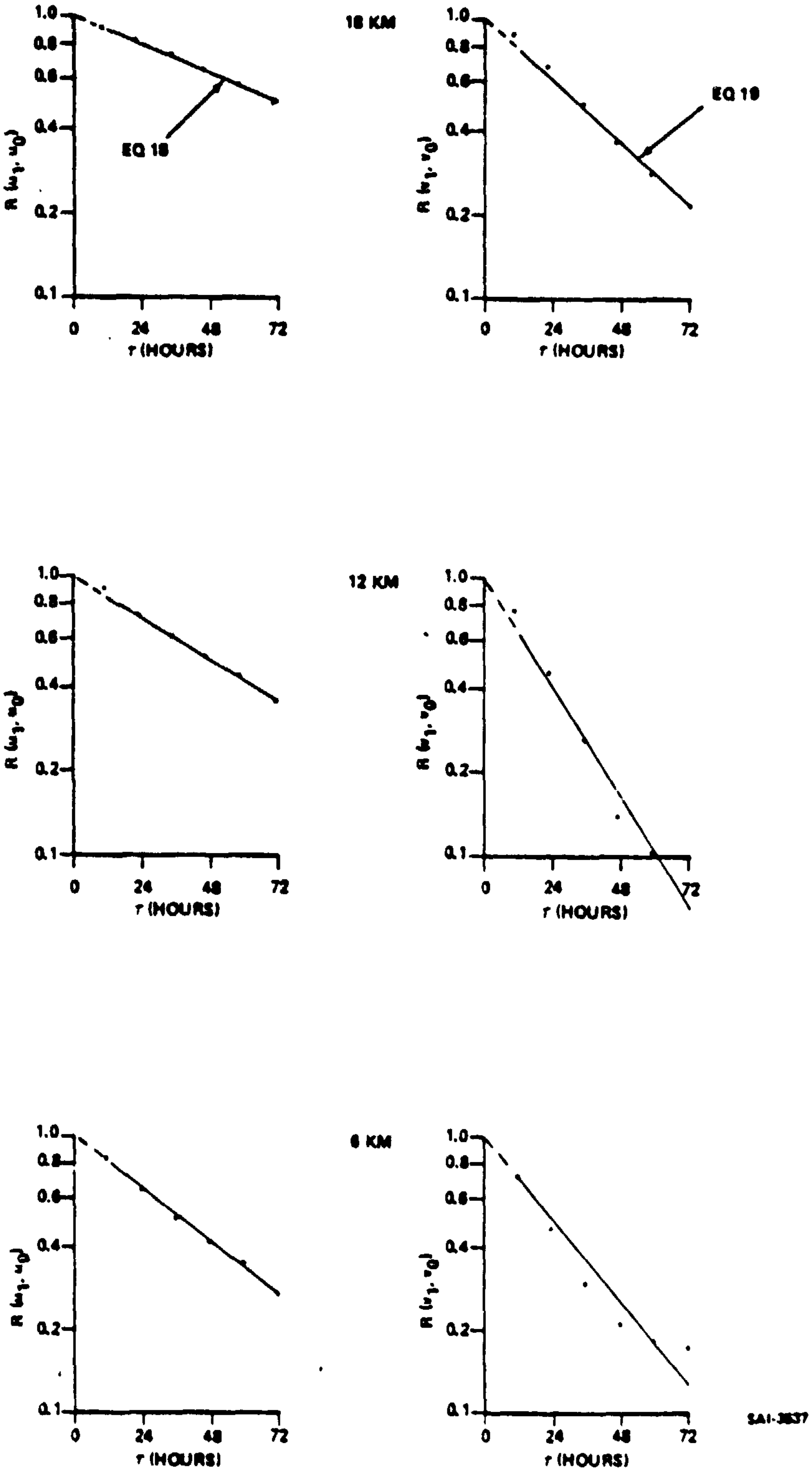

Figure 3. Zonal and Meridional Wind Bias Component Autocorrelation During January at 6, 12 and 18 km at Vandenberg AFB (1965-74)

Equations 22 and 23 indicate that $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ are asymptotic to $\sqrt{2}\ \sigma_u$ and $\sqrt{2}\ \sigma_v$ for large values of τ. Therefore, estimates of the extreme value of $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ are obtained by setting τ equal to ∞ in equations 22 and 23.

The calculated values of b and c at altitudes from 5 to 22 km over KSC in April and VAFB during January listed in Table 2 are also plotted in Figures 4 and 5. At both locations at altitudes from 5 to 22 km the decay rate of the meridional wind bias component autocorrelation is larger than the decay rate for the zonal component. The variation of the decay rate for the meridional component as a function of altitude differs at the two locations. Maximum decay for the meridional component occurs at 12 - 13 km over VAFB during January; in contrast, at KSC during April, the maximum occurs at the extremes of altitude range (near 5 and 22 km) and is a minimum at 15 km. The decay of zonal component autocorrelation decreases steadily with altitude at VAFB during January. At KSC during April the decay also decreases with altitude but at a very rapid rate and within a restricted altitude range (5 - 15 km); above 15 km the decay increases.

The calculated and observed values of $\sigma_{\Delta u}(\tau)$ and $\sigma_{\Delta v}(\tau)$ at 6, 12, and 18 km during April at KSC and January at VAFB are listed in Tables 3 and 4. The estimated extreme values of $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$, ($\sqrt{2}\ \sigma_u$ and $\sqrt{2}\ \sigma_v$, respectively), are listed at the bottom of each column of calculated values. The comparisons in Tables 3 and 4 indicate that $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ can be accurately estimated by application of Equations 22 and 23, respectively. General application of this estimation technique at other locations would require a more adequate knowledge of the form of the autocorrelation function than is presently available.

The theoretical distribution of wind bias component differences has been derived from sample estimates of $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ and $\overline{\Delta u}$ and $\overline{\Delta v}$ (given in the appendix) for the intervals of 12, 24, 36 and 48 hours at 12 km during April at KSC and January at VAFB; the theoretical normal distributions are plotted as straight lines in Figures 6 through 9; the plotted symbols represent the observed distributions of Δu and Δv. It is indicated that the observed distribution of bias component changes is accurately represented

Z (km)	VAFB (JANUARY) $10^2 b$ (hr^{-1})	VAFB (JANUARY) $10^2 c$ (hr^{-1})	KSC (APRIL) $10^2 b$ (hr^{-1})	KSC (APRIL) $10^2 c$ (hr^{-1})
5	1.79	2.72	1.17	2.96
6	1.80	2.83	1.08	2.64
7	1.80	2.99	1.04	2.43
8	1.78	3.16	1.02	2.32
9	1.72	3.33	1.02	2.25
10	1.63	3.49	0.99	2.21
11	1.52	3.64	0.96	2.15
12	1.41	3.74	0.89	2.06
13	1.32	3.77	0.85	1.97
14	1.25	3.67	0.81	1.89
15	1.21	3.42	0.80	1.86
16	1.18	3.04	0.80	1.89
17	1.09	2.57	0.82	1.99
18	0.96	2.11	0.84	2.14
19	0.81	1.76	0.86	2.38
20	0.70	1.50	0.90	2.79
21	0.65	1.37	0.98	3.71
22	0.63	1.34	1.10	3.34

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Table 2. Constants b and c of Equations 18 and 19 at Altitudes from 5 to 22 km During January at VAFB (1965-74) and During April at Cape Kennedy (1956-70)

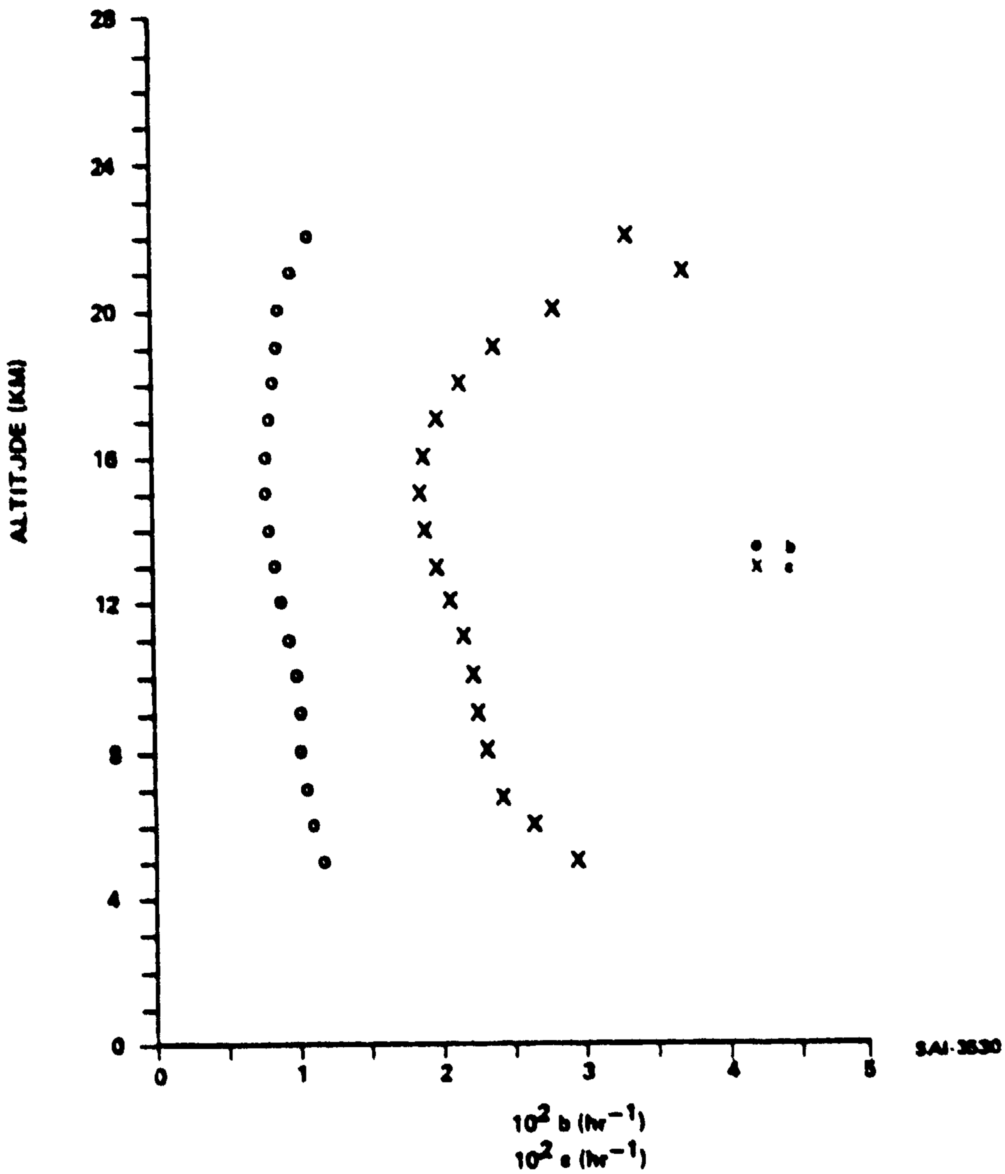

Figure 4. Constants b and c of Equations 18 and 19 for Cape Kennedy During April (1956-70)

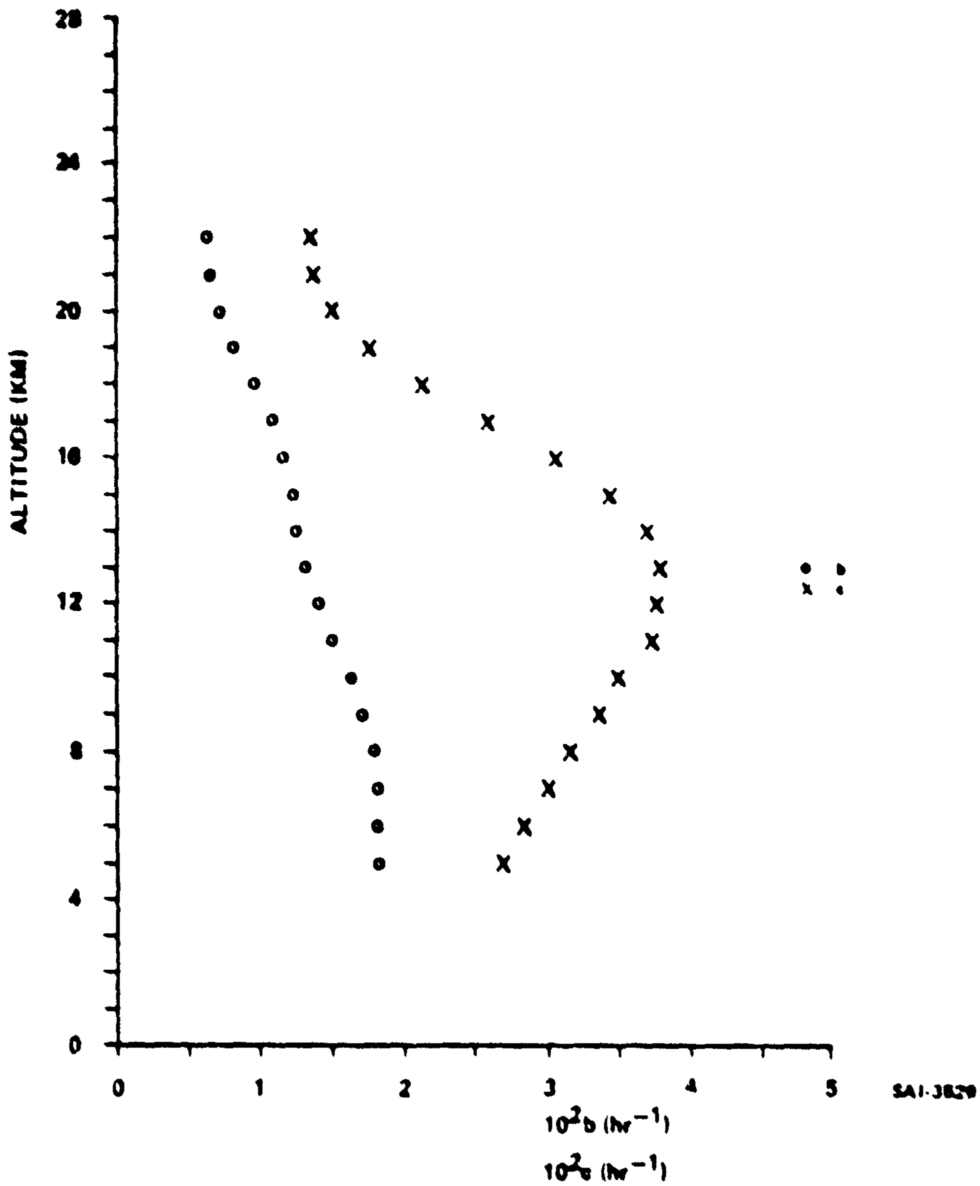

Figure 5. Constants b and c of Equations 18 and 19 for Vandenberg AFB During January (1965-74)

ALTITUDE (KM)	t (HOURS)	$\sigma_{\Delta u}$		$\sigma_{\Delta v}$	
		CALCULATED	OBSERVED	CALCULATED	OBSERVED
18	12	3.11	3.17	3.20	2.60
	24	4.29	4.13	4.26	3.89
	36	5.13	5.04	4.92	4.78
	48	5.78	5.70	5.38	5.33
	60	6.32	6.24	5.71	5.72
	72	6.76	6.59	5.95	5.99
	∞	10.04	—	—	—
12	12	7.00	6.23	7.89	7.28
	24	9.65	9.28	10.53	10.35
	36	11.52	11.50	12.20	12.34
	48	12.97	12.94	13.36	13.44
	60	14.15	14.05	14.20	14.23
	72	15.14	14.92	14.[illegible]2	14.65
	∞	—	—	—	—
6	12	5.12	4.74	5.11	4.75
	24	7.01	7.04	6.72	6.59
	36	8.33	8.53	7.69	7.83
	48	9.34	9.36	8.32	8.52
	60	10.14	10.03	8.75	8.76
	72	10.79	10.54	9.05	8.82
	∞	14.68	—	—	—

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Table 3. Calculated [Eqs. 22 and 23] and Observed $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ from Wind Bias Profiles During April at Cape Kennedy at 6, 12, and 18 km

ALTITUDE (KM)	T (HOURS)	$\sigma_{\Delta u}$		$\sigma_{\Delta v}$	
		CALCULATED	OBSERVED	CALCULATED	OBSERVED
18	12	3.20	2.97	3.56	2.86
	24	4.40	4.08	4.75	4.42
	36	5.24	5.03	5.49	5.44
	48	5.89	5.75	6.01	6.07
	60	6.42	6.48	6.38	6.43
	72	6.85	7.03	6.66	6.65
	∞	9.72	--	7.52	
12	12	9.16	8.12	12.23	9.91
	24	12.43	12.16	15.65	15.04
	36	14.64	14.66	17.49	17.56
	48	16.27	16.17	18.57	18.83
	60	17.63	17.33	19.23	19.16
	72	18.53	18.61	19.63	19.40
	∞	23.19	--	20.34	--
6	12	7.62	6.96	9.00	8.66
	24	10.23	10.13	11.78	12.22
	36	11.93	11.89	13.41	14.05
	48	13.14	12.94	14.47	14.79
	60	14.04	13.75	15.17	14.97
	72	14.73	14.62	15.66	15.13
	∞	17.28	--	16.79	--

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Table 4. Calculated [Eqs. 22 and 23] and Observed $\sigma_{\Delta u}$ and $\sigma_{\Delta v}$ from Wind Bias Profiles During January at Vandenberg AFB at 6, 12 and 18 km

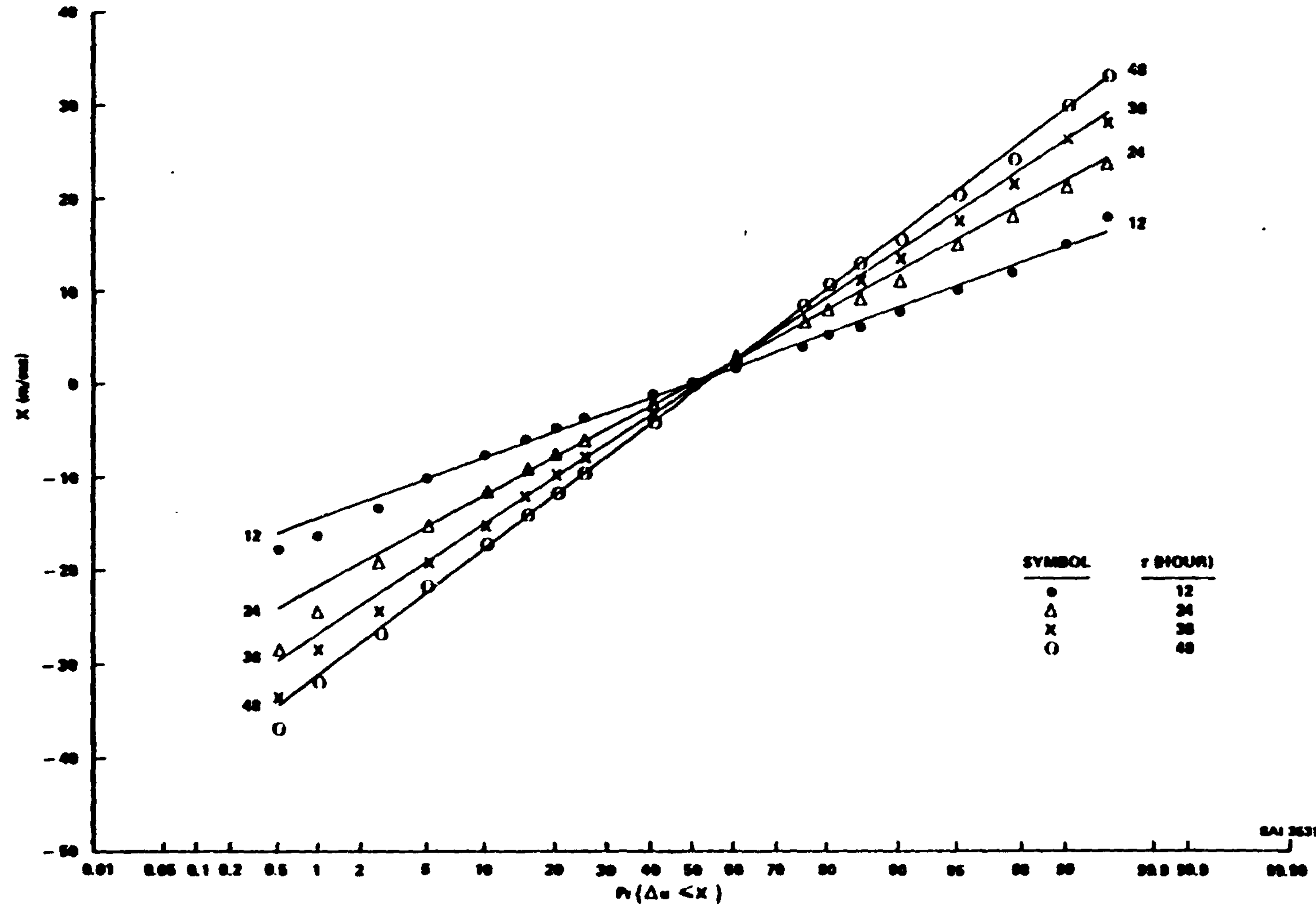

Figure 6. Theoretical (Straight Lines) and Observed (Plotted Points) Cumulative Probability Distribution of Zonal Wind Bias Component Change, Δu, with Respect to Time Increment, τ, During April at 12 km Over Cape Kennedy (1956-70)

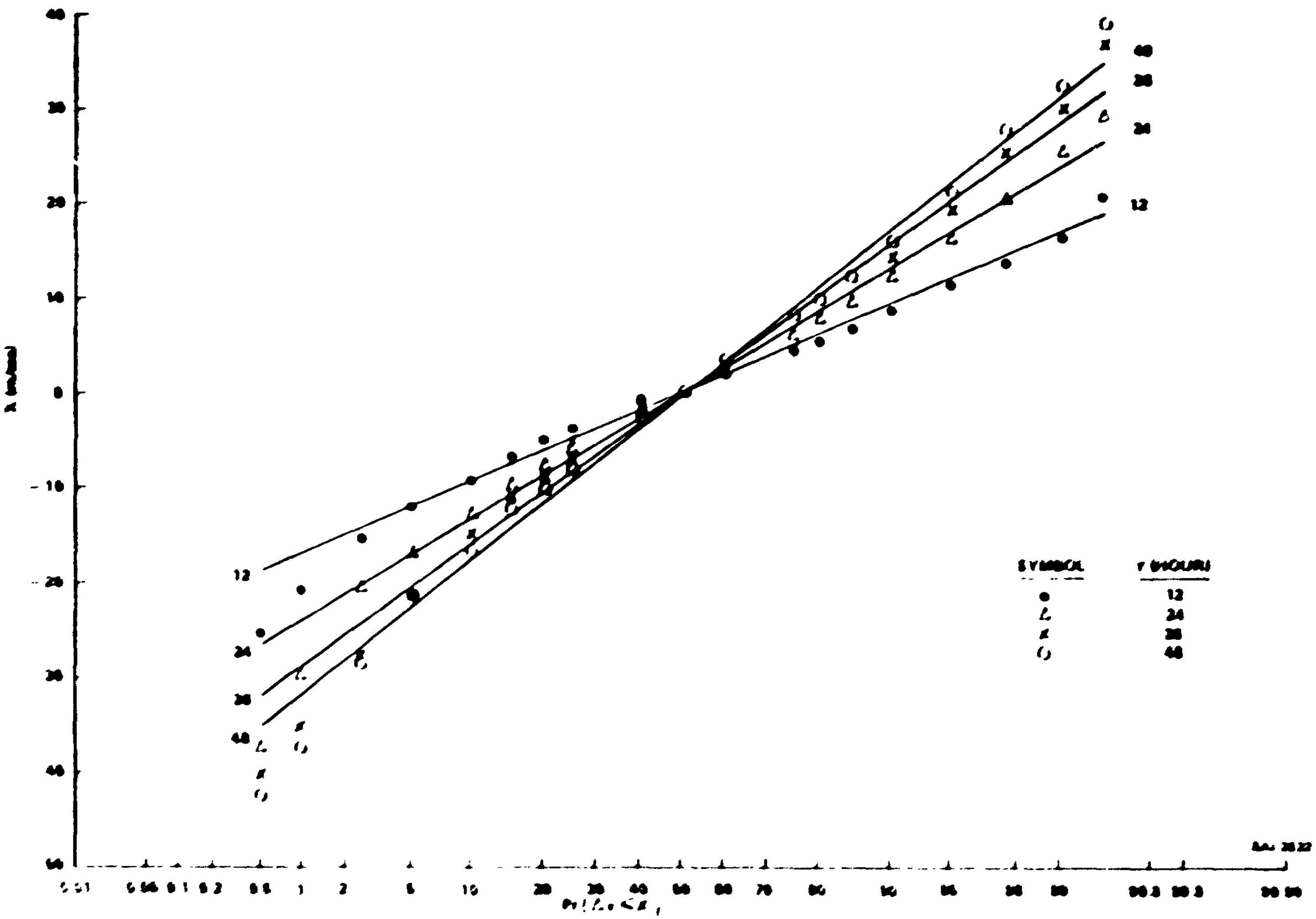

Figure 7. Theoretical (Straight Lines) and Observed (Plotted Points) Cumulative Probability Distribution of Meridional Wind Bias Component Change, Δx, with Respect to Time Increment, τ, During April at 12 km Over Cape Kennedy (1956-70)

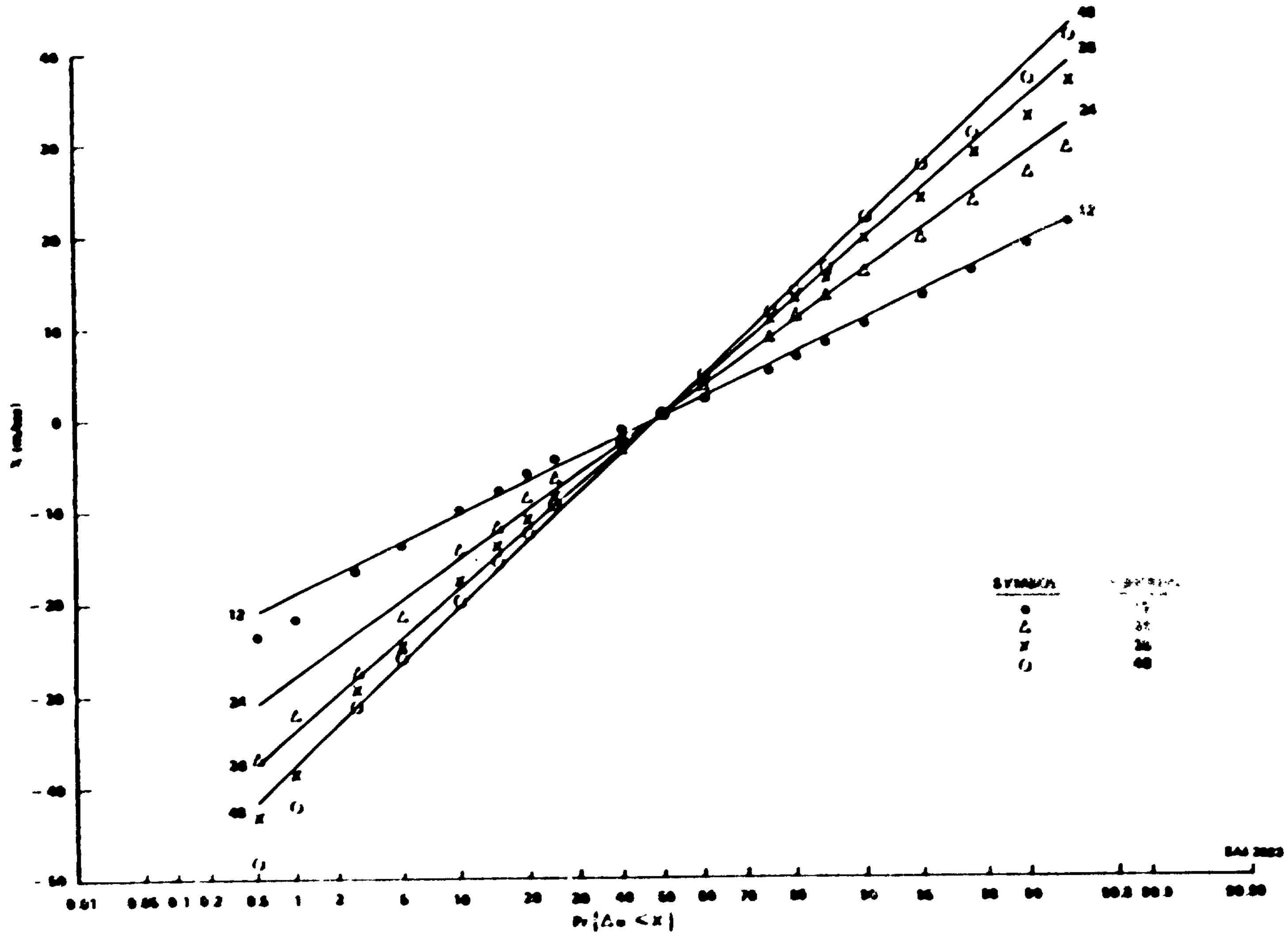

Figure 8. Theoretical (Straight Lines) and Observed (Plotted Points) Cumulative Probability Distribution of Zonal Wind Bias Component Change, Δu, with Respect to Time Increment, τ, During January at 12 km Over Vandenberg AFB (1965-74)

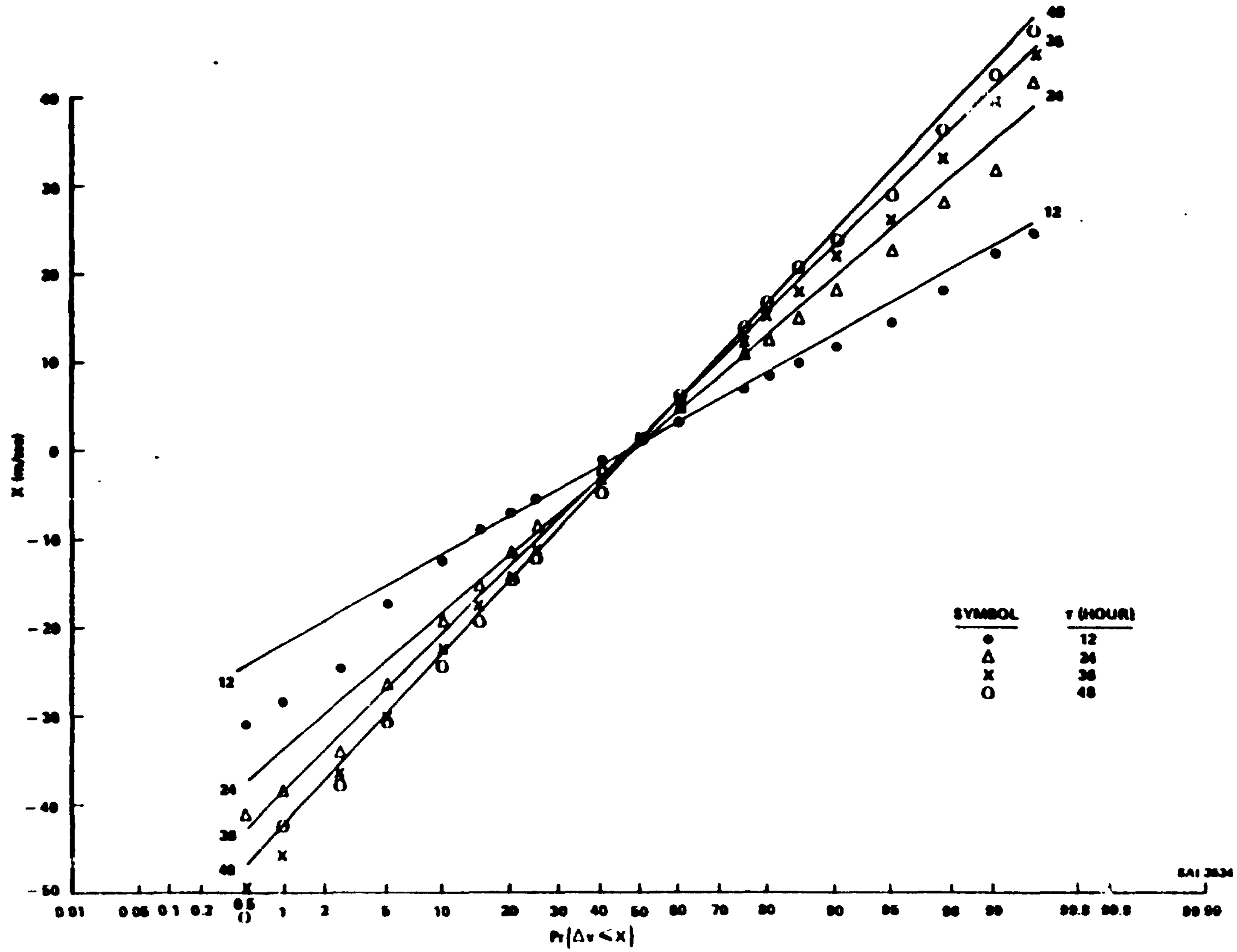

Figure 9. Theoretical (Straight Lines) and Observed (Plotted Points) Cumulative Probability Distribution of Meridional Wind Bias Component Change, Δv, with Respect to Time Increment, τ, During January at 12 km Over Vandenberg AFB (1965-74)

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by the theoretical normal distribution for a large range of probabilities; the deviation of the observed distribution from the theoretical distribution at the extreme probabilities is attributed to the small sample of observations and errors in the Rawinsonde data.

C. JOINT DISTRIBUTION OF WIND BIAS COMPONENT CHANGES WITH RESPECT TO TIME

The joint distribution of zonal and meridional wind bias component change with respect to time (Δu and Δv) can be approximated by a bivariate normal distribution. A useful property of such a distribution is that an ellipse can be calculated which contains the end points of a specified percent of vectors having components Δu and Δv. A detailed description of the derivation of probability ellipses and plotting methodology is given by Smith [3]. The five parameters of the bivariate normal distribution of Δu and Δv, calculated for each monthly reference period at KSC and VAFB at 1 km altitude intervals from 5 to 22 km are listed in the appendix.

The degree of approximation of the bivariate normal distribution to the observed distribution can be evaluated by comparison of the observed percentage of vectors which are contained within the ellipse to that predicted by the ellipse at a specified probability level. For example, for a sample of 1,000 vectors, 950 of the vectors should terminate within the 95 percent (theoretical $P = .95$) ellipse calculated from the bivariate statistics of the 1,000 vectors; however, a plot of the 1,000 vectors could indicate that only 945 vectors (observed $p = .945$) terminate within the 95 percent ellipse. For illustration on a linear graph comparison of the theoretical to the observed P is given in terms of the parameter λ_e given by

$$\lambda_e = \sqrt{2}\,\sqrt{-\ln(1-P)} \qquad (24)$$

A comparison of theoretical and observed values of λ_e at 12 km during April at KSC and January at VAFB for time intervals of 12, 24, 36 and 48 hours is illustrated in Figures 10 and 11. Perfect agreement between theoretical and observed λ_e is represented by a line drawn from the origin with a slope, B, equal to 1. The calculated least squares slopes are given in the figure legend. The plots indicate a tendency for the theoretical λ_e to exceed the

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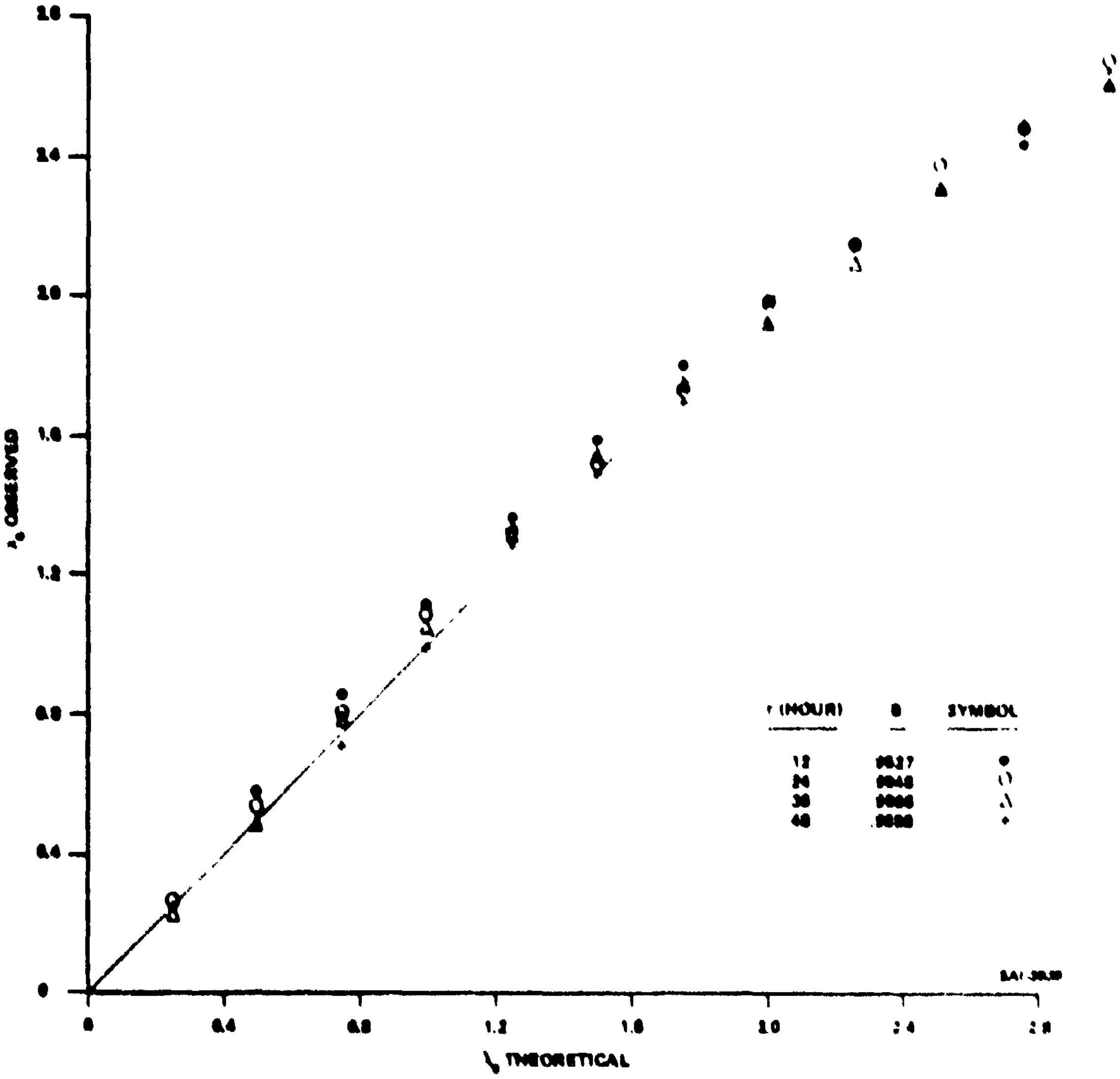

Figure 10. Observed λ_e as a Function of Theoretical λ_c for a Bivariate Normal Distribution of Wind Bias Component Changes (Δu, Δv) with Respect to Time at 12 km During April (1956-70) at Cape Kennedy

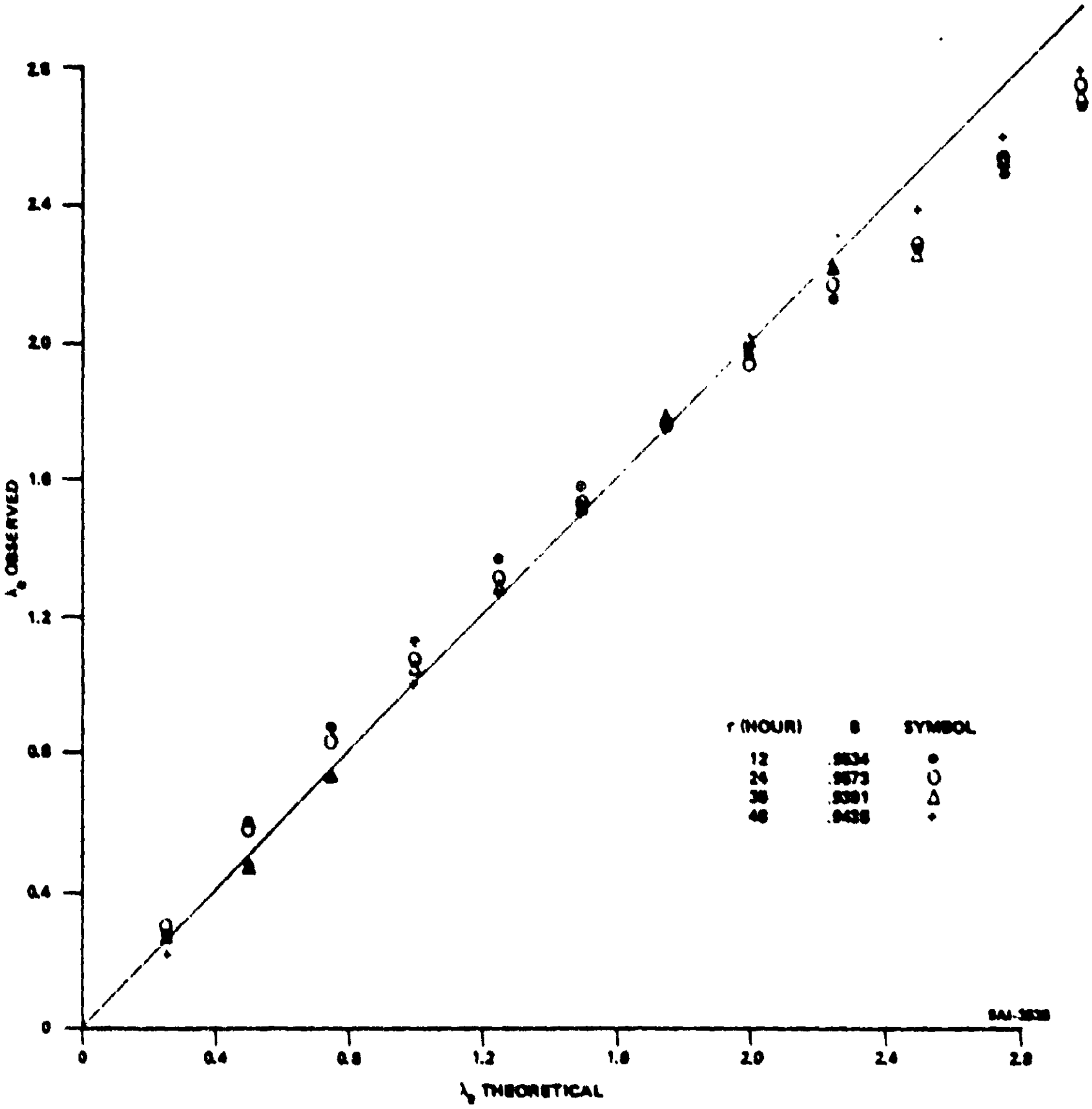

Figure 11. Observed λ_e as a Function of Theoretical λ_e for a Bivariate Normal Distribution of Wind Bias Component Chnages (Δu, Δv) with Respect to Time at 12 km During January (1965-74) at Vandenberg AFB

observed λ_e for large values of λ_e. The interpretation of this result is that for extreme probabilities the theoretical distributions predict fewer wind change vectors terminating outside the ellipse than is observed. These results may have to be taken into consideration if engineering application of theoretical wind change statistics beyond 95 percent level is required.

The 95 percent probability ellipses for the joint distribution of wind bias component changes with respect to time at 6, 12, and 18 km during April at KSC and January at VAFB are illustrated in Figure 12; the relatively large changes with respect to time at 12 km is clearly illustrated at both locations.

D. MODULUS OF VECTOR WIND BIAS CHANGE WITH RESPECT TO TIME

If wind bias change with respect to time has a distribution which is bivariate normal, the modulus R, of the wind bias change vector (defined by Equation 5) has a Rayleigh distribution. Since the Rayleigh distribution cannot be integrated in closed form, numerical integration is required to obtain the cumulative probability distribution. Derivation of the Rayleigh distribution, given the five bivariate normal distribution statistics, requires summation involving products of the modified Bessel function of the first kind. Smith [3] summarizes the basic equations for the Rayleigh distribution derived by Wier [5] and extended by Yadavalli [6] to include the condition for correlated variables. The Rayleigh distribution reduces to the integrable classical form if it is assumed that the components of the vector wind change are independent and that they have zero means and equal standard deviations; the classical Rayleigh probability density function is

$$f(R) = \frac{R}{\sigma^2} \text{EXP} \left(-R^2/2\sigma^2\right) \quad R \geq 0 \qquad (25)$$

Integration of Equation 25 from zero to a specified value of R yields the cumulative probability that $R \leq R^*$ where,

$$\Pr\left\{R \leq R^*\right\} = 1 - \text{EXP}\left(-R^2/2\sigma^2\right) \quad R \geq 0 \qquad (26)$$

where $\sigma = \sigma_{\Delta u} = \sigma_{\Delta v}$

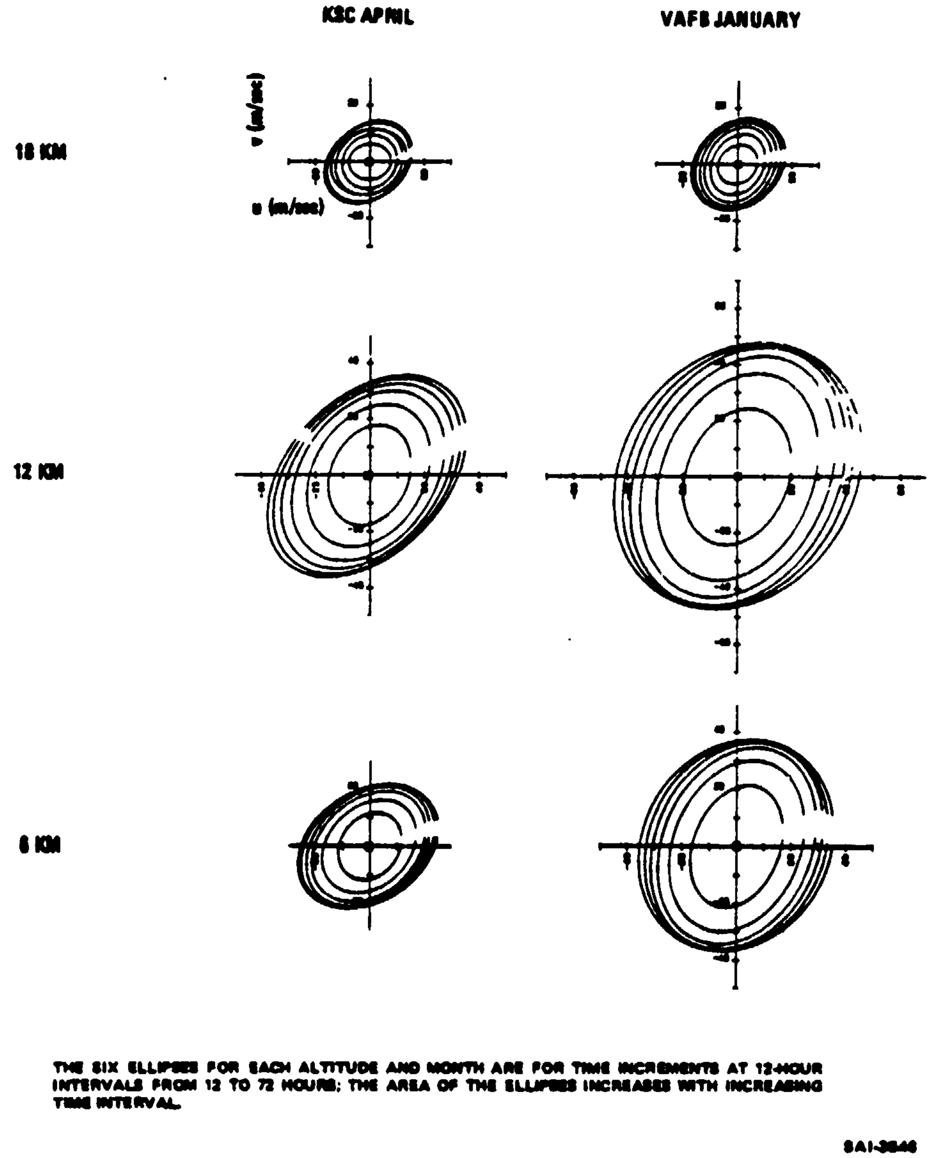

Figure 12. Joint Distribution of 95 Percent Wind Bias Component Changes with Respect to Time at 6, 12 and 18 km During April at Cape Kennedy (1956-70) and January at Vandenberg (1965-74)

Since the standard deviation of the component difference can be expressed as a function of the standard deviation of the components (Equations 22 and 23) it follows that

$$Pr\left\{R \leq R^*\right\} = 1 - EXP\left[-\frac{R^2}{4\sigma_k^2\ [1-EXP\ (-k\tau)]}\right] \qquad (27)$$

where σ_k and k correspond to either σ_u and b or σ_v and C given in Equations 22 and 23.

An expression for R given a particular probability, $Pr\ [R \leq R^*]$, is obtained by solution of Equation 27 to obtain

$$R = \sqrt{2}\ \ \lambda_e \sigma_k \sqrt{1 - EXP\ (-k\tau)} \qquad (28)$$

where λ_e is derived from Equation 24 denoting $Pr\ [R \leq R^*]$ by P

The choice of $\sigma_k = \sigma_v$ and k = c (from Equation 23) at 12 km during April at KSC and January at VAFB yields the most accurate approximation of the cumulative Rayleigh distribution obtained by numerical integration of Equation 28 in Reference 1. Comparisons of the 99, 95, and 50 percentile modulus of the wind change vector with respect to time based on the Rayleigh (Equation 28, Reference 1) and the classical Rayleigh (Equation 27) are illustrated in Figures 13 and 14; the rather good agreement between the distributions for time intervals from 12 to 72 hours is attributable to the accuracy of the simplifying assumptions described above. There is a slight tendency, especially for time intervals $\lesssim$36 hours for the classical Rayleigh to be larger than the Rayleigh.

The remaining question is: How well do these theoretical distributions compare with observed observations? Comparisons of observed and theoretical values of R for time intervals of 12, 24 36 and 48 hours at 12 km during November, December and January at VAFB are given in Tables 5 and 6; column II of the tables contains R calculated according to the classical Rayleigh distribution with σ equal to the monthly value of σ_v at 12 km and k equat to the decay constant, c, in the monthly exponential least squares

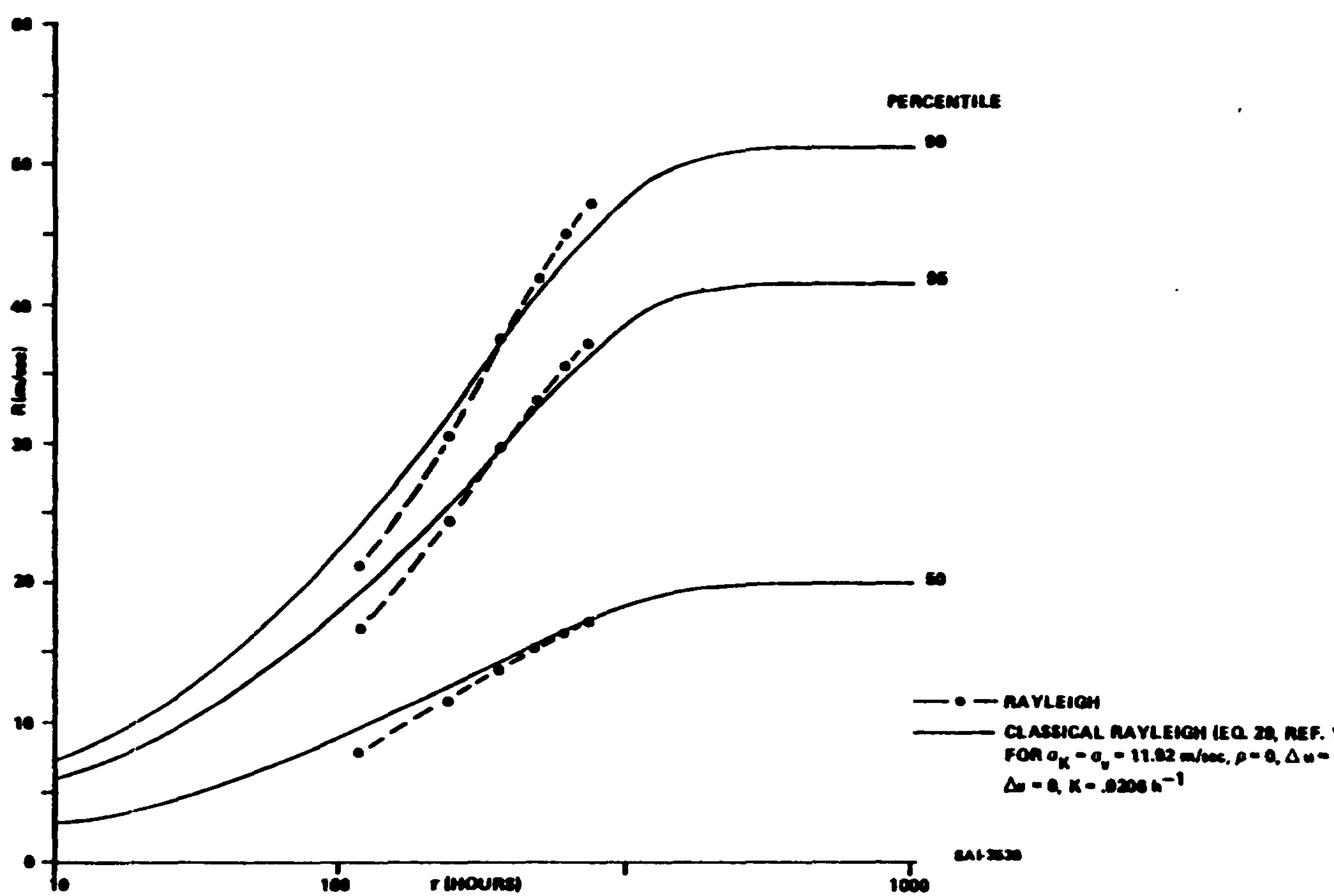

Figure 13. April Theoretical Percentiles of Modulus, P, of Vector Wind Bias Change with Respect to Time Interval, τ, at 12 km Over Cape Kennedy (1956-70)

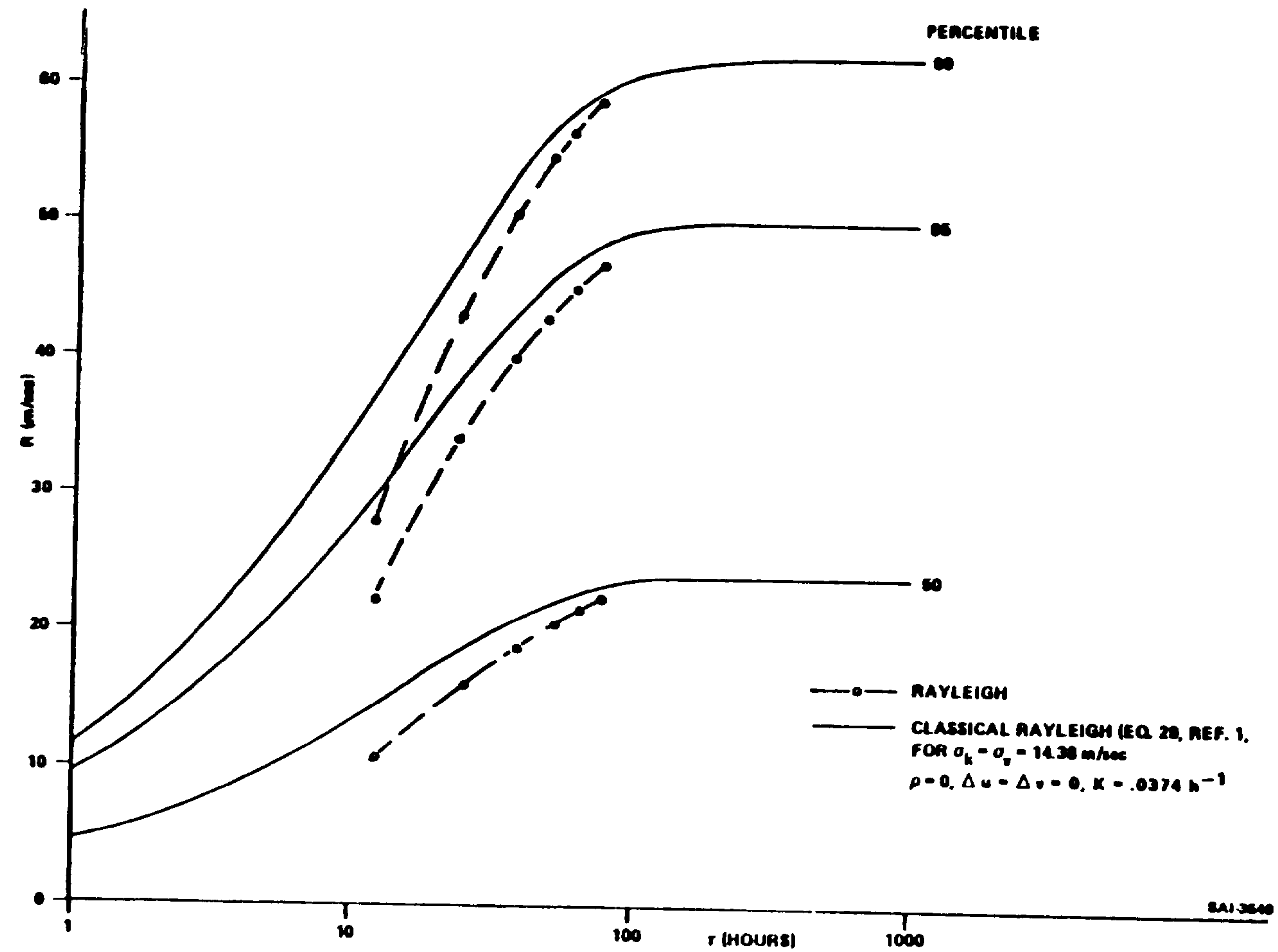

Figure 14. January Theoretical Percentiles of Modulus, R, of Vector Wind Bias Change with Respect to Time Interval, τ, at 12 km Over Vandenberg AFB (1965-74)

τ (HOURS)	12			24			36			48		
$Pr\{R \leq R^*\}$	I	II	OBSERVED	I	II	OBSERVED	I	II	OBSERVED	I	II	OBSERVED
.50	7.89	9.29	7.01	11.41	12.40	10.08	13.80	14.36	12.68	15.20	15.73	14.21
.60	9.09	10.68	8.11	13.15	14.25	11.80	15.92	16.51	14.60	17.56	18.08	16.52
.75	11.25	13.14	10.34	16.28	17.53	15.71	19.73	20.31	18.86	21.78	22.24	20.85
.80	12.14	14.15	11.47	17.59	18.89	17.30	21.33	21.89	20.48	23.57	23.97	22.56
.84134	13.00	15.14	12.56	18.86	20.20	18.46	22.88	23.41	22.35	25.31	25.63	24.41
.85	13.22	15.37	12.81	19.15	20.51	18.71	23.25	23.76	22.87	25.73	26.02	24.80
.90	14.63	16.93	15.05	21.21	22.51	21.36	25.77	26.18	26.57	28.55	28.67	28.00
.95	16.78	19.31	17.80	24.39	25.77	25.50	29.68	29.86	31.37	32.93	32.70	33.20
.97502	18.74	21.43	21.38	27.26	28.60	30.36	33.24	33.14	36.88	36.93	36.29	39.70
.97725	18.96	21.70	21.88	27.63	28.96	30.65	33.70	33.55	37.76	37.46	36.75	40.26
.98734	20.51	23.32	25.87	29.85	31.12	34.54	36.46	36.06	41.40	40.57	39.49	48.30
.99000	21.06	23.94	26.40	30.73	31.95	37.00	37.53	37.02	42.00	41.77	40.54	51.00
.99500	22.73	25.68	27.50	33.15	34.27	42.75	40.54	39.71	48.60	45.16	43.49	59.75

COLUMN I: CALCULATIONS OF R BASED ON EQS. 28a AND 28b OF REF. 1 AND NUMERICAL INTEGRATION OF THE RAYLIEGH PROBABILITY DENSITY FUNCTION.

COLUMN II: CALCULATIONS OF R BASED ON EQ.30 OF THIS TEXT AND ASSUMING $\sigma = \sigma_v$ = 11.92 m/sec, K = C = .0206 hr^{-1} AND $\Delta u = \Delta v = 0$.

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Table 5. Theoretical and Observed Modulus, R(m/sec), of Vector Wind Bias Change with Respect to Time Interval, τ, During April (1956-70) at 12 km Over Cape Kennedy

τ (HOURS)	12			24			36			48		
$Pr\{R < R^*\}$	I	II	OBSERVED	I	II	OBSERVED	I	II	OBSERVED	I	II	OBSERVED
.50	10.52	14.39	9.47	15.82	18.43	14.76	18.73	20.59	18.25	20.38	21.86	19.91
.60	12.13	16.55	11.22	18.25	21.18	17.74	21.61	23.67	21.42	23.49	25.14	23.55
.75	17.99	20.36	14.35	22.60	26.06	21.88	26.74	29.12	25.93	29.04	30.92	28.53
.80	16.20	21.93	15.62	24.43	28.00	23.89	28.90	31.38	28.17	31.37	33.31	30.58
.84134	17.38	23.46	16.68	26.21	30.03	26.23	31.00	33.56	30.47	33.64	35.63	33.08
.850	17.65	23.81	16.95	26.63	30.48	27.00	31.50	34.07	30.92	34.17	36.17	33.75
.900	19.64	26.23	20.18	29.50	33.58	30.60	34.87	37.53	34.50	37.81	39.85	37.60
.95	22.45	29.92	24.86	33.84	38.31	35.33	40.12	42.81	41.50	43.44	45.45	42.40
.97502	25.06	33.21	28.10	37.98	42.51	40.17	44.88	47.51	46.51	48.55	50.44	48.76
.97725	25.42	33.63	28.38	38.52	43.05	40.63	45.50	48.11	47.30	49.18	51.08	50.45
.98734	27.47	36.14	32.15	41.66	46.26	44.79	49.19	51.70	51.15	53.14	54.89	56.58
.99	28.25	37.10	33.40	42.87	47.49	45.80	50.62	53.08	52.80	54.67	56.35	57.80
.995	30.49	39.80	35.90	46.30	50.94	49.90	54.65	56.93	59.90	58.96	60.44	60.90

COLUMN I: CALCULATIONS OF R BASED ON EQS. 28a AND 28b OF REF. 1 AND NUMERICAL INTEGRATION OF THE RAYLIEGH PROBABILITY DENSITY FUNCTION.

COLUMN II: CALCULATIONS OF R BASED ON EQ. 30 OF THIS TEXT AND ASSUMING $\sigma = \sigma_v$ = 14.38 m/sec, K = C = .0374 hr^{-1} and $\angle u = \angle v = 0$.

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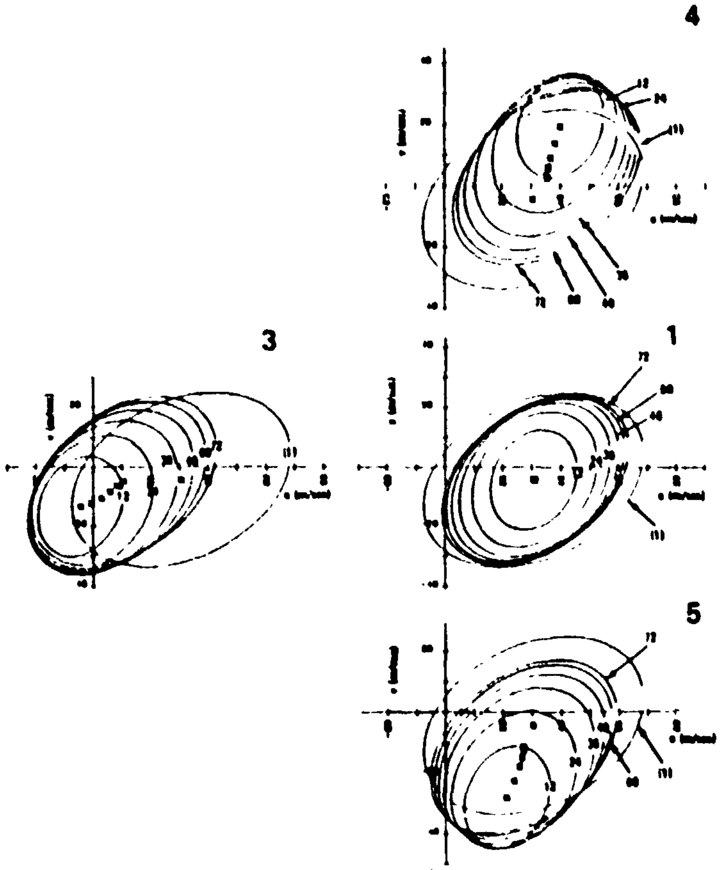
Table 6. Theoretical and Observed Modulus, R(m/sec), of Vector Wind Bias Change with Respect to Time Interval, τ, During January (1965-74) at 12 km Over Vandenberg AFB

fit to the v component autocorrelation function (Equation 23); Column I was obtained by numerical integration of the Rayleigh distribution. It is indicated that the observed cumulative distribution agrees fairly well with the theoretical distribution for probabilities less than .95 to .975. For large probabilities, there is a consistent tendency for the theoretical distribution to underestimate the observed distribution. This tendency is attributable to the small sample of data avilable at the extreme probabilities and errors in the Rawinsonde data.

E. CONDITIONAL VECTOR WIND BIAS ELLIPSES

Prior knowledge that environmental constraints necessary to assure the success of a space vehicle launch will be satisfied implies that there is a capability for prediction of environmental parameters; the prediction can be based on knowledge of conditions prior to launch. With regard to winds aloft, prior conditions are typically based on Rawinsonde or Jimsphere wind profiles. A typical question that could be posed before launch is: Given a measurement of the wind bias vector 12 prior to launch at 12 km, will the wind bias vector at launch time be within 95 percent reference month wind ellipse? A question of this type can be answered if the distribution of vector wind bias components at an initial time, T_0, and at a future time, T_1, can be approximated by a quadravariate normal distribution. Given the components of the bias vector at T_0, the conditional distribution of the bias vector at T_1 is bivariate normal. Smith [1] describes the derivation of the conditional bivariate normal distribution and documents the computer program used in this investigation for calculation of these distributions. Figures 15 and 16 illustrate the 95 percent conditional bivariate normal distributions at 12 km that have been calculated for time increments of 12, 24, 36, 48, 60 and 72 hours for the month of April at KSC and January at VAFB. Five vectors were selected as given initial conditions for calculations of the conditional ellipses. The components of the vectors are defined below:

1. Monthly bias component means
2. Maximum zonal wind bias and the corresponding meridional wind bias from the monthly 95 percent vector wind bias ellipse.
3. Minimum zonal wind bias and the corresponding meridional wind bias from the monthly 95 percent vector wind bias ellipse.



CONDITION	R (M/SEC)	θ_{MET} (DEG)
1	30.6	278.0
2	[illegible]	[illegible]
3	18.2	30.0
4	48.7	230.0
5	[illegible]	331.0

(1) April 95 Percent Vector Wind Bias Ellipse

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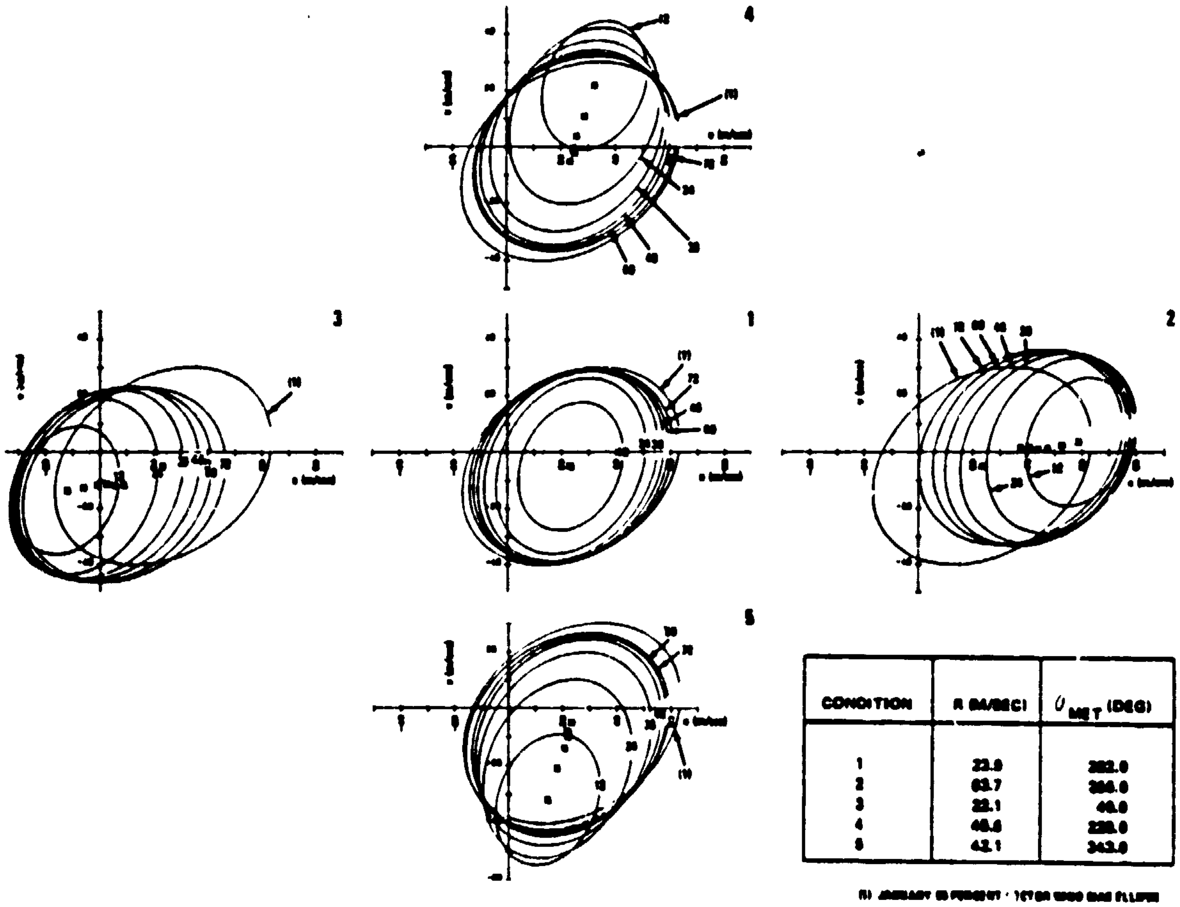
Figure 15. April Conditional 95 Percent Wind Bias Ellipses at 12 km for Time Increments of 12, 24, 36, 48, 60 and 72 Hours at Cape Kennedy (1956-70)



CONDITION	R (M/SEC)	θ_{MET} (DEG)
1	22.9	282.0
2	63.7	286.0
3	22.1	46.0
4	46.6	228.0
5	42.1	343.0

Figure 16. January Conditional 95 Percent Wind Bias Ellipses at 12 km for Time Increments of 12, 24, 36, 48, 60 and 72 Hours at Vandenberg AFB (1965-74)

4. Maximum meridional wind bias and the corresponding zonal wind bias from the monthly 95 percent vector wind bias ellipse.
5. Minimum meridional wind bias and the corresponding zonal wind bias from the monthly 95 percent vector wind bias ellipse.

The given vectors are specified in the inset of Figures 15 and 16 (polar form, at 12 km) and in Tables 7 and 8 (component form, at 6, 12, 18 km).

The conditional ellipses illustrated at the center of Figures 15 and 16 show that if the observed wind vector has components equivalent to the monthly mean bias components (condition 1) then 95 percent of the wind vectors after elapsed times as large as 72 hours will fall within the monthly 95 percent ellipse. Therefore, satisfaction of a launch constraint which states that the wind bias vector must be included within the 95 percent monthly ellipse would be assured for periods as long as 72 hours following an observation of a wind vector having components which correspond to the monthly means. The conditional ellipses based on selection of given wind bias vectors that terminate on the monthly 95 percent ellipse (conditions 2 through 5) have a significant proportion of their area lying outside the monthly 95 percent ellipse; as the time increment increases this proportion decreases but remains significant for a time increment as large as 72 hours. This implies that a significant proportion of wind bias vectors will not satisfy a launch constraint based on the 95 percent wind bias ellipse for periods as long as 72 hours (or longer if these calculations are extended) following an observation of a wind bias vector which terminates on the 95 percent ellipse.

The wind direction characteristics of a wind bias ellipse can be described in terms of the angles associated with wind bias vectors constructed between the origin and the center of the ellipse (at the component means) and between the origin and the two tangent positions to the ellipse. The three vectors constructed in this manner and the angles θ_A, θ_B, θ_E and $\Delta\theta$ are illustrated in Figure 17, the range of wind angles, θ_R, is θ_A to θ_B. The angles θ_R, θ_E, $\Delta\theta$ calculated from five 95 percent conditional ellipses for April at KSC and January at VAFB at 6, 12 and 18 km are listed in Tables 7 and 8.

CONDITION (*)	θ_e	θ_A	θ_B	$\Delta\theta$
1	278	248	313	65
2	2b8	252	281	39
3	20	•	•	•
4	244	225	266	41
5	323	293	349	56

(*) THE FIVE CONDITIONAL DISTRIBUTIONS ARE BASED ON THE FIVE GIVEN WIND VECTORS LISTED BELOW. CONDITION 1 IS BASED ON MONTHLY MEAN WIND BIAS COMPONENTS FOR THE PERIOD 1956–70; CONDITIONS 2 THRU 5 ARE FROM THE 95 PERCENT VECTOR WIND BIAS ELLIPSE AT 12 KM THAT WAS CALCULATED FROM TWICE DAILY FILTERED RAWINSONDE DATA DURING THE PERIOD 1956–70.

• 95 PERCENT CONDITIONAL ELLIPSE COVERS ALL QUADRANTS.

CONDITIONS		M/SEC	
1	u, v	30.44	− 4.35
2	u_{max}, v	68.53	4.46
3	u_{min}, v	− 7.65	− 13.16
4	u, v_{max}	41.94	24.83
5	u, v_{min}	18.94	− 33.53

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Table 7. Wind Direction (Degrees) Characteristics of 95 Percent Conditional Vector Wind Bias Ellipses at 12 km Over Cape Kennedy During April for an Elapsed Time, τ, of 12 Hours

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CONDITION(*)	θ_{e}	θ_{A}	θ_{B}	$\Delta\theta$
1	282	229	343	114
2	266	246	290	44
3	41	•	•	•
4	236	208	272	64
5	336	293	8	75

(*) THE FIVE CONDITIONAL DISTRIBUTIONS ARE BASED ON THE FIVE GIVEN WIND VECTORS LISTED BELOW. CONDITION 1 IS BASED ON MONTHLY MEAN WIND BIAS COMPONENTS FOR THE PERIOD 1966–74; CONDITIONS 2 THRU 5 ARE FROM THE 95 PERCENT VECTOR WIND BIAS ELLIPSES AT 12 KM THAT WERE CALCULATED FROM TWICE DAILY FILTERED RAWINSONDE DATA DURING THE PERIOD 1966–74.

• 95 PERCENT CONDITIONAL ELLIPSE COVERS ALL QUADRANTS.

CONDITION		M/SEC	
1	u, v	23.36	− 4.95
2	u_{max}, v	63.50	4.47
3	u_{min}, v	− 16.78	− 14.37
4	u, v_{max}	34.11	30.26
5	u, v_{min}	12.61	− 40.15

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Table 8. Wind Direction (Degrees) Characteristics of 95 Percent Conditional Vector Wind Bias Ellipses at 12 km Over Vandenberg AFB During January for an Elapsed Time, τ, of 12 Hours

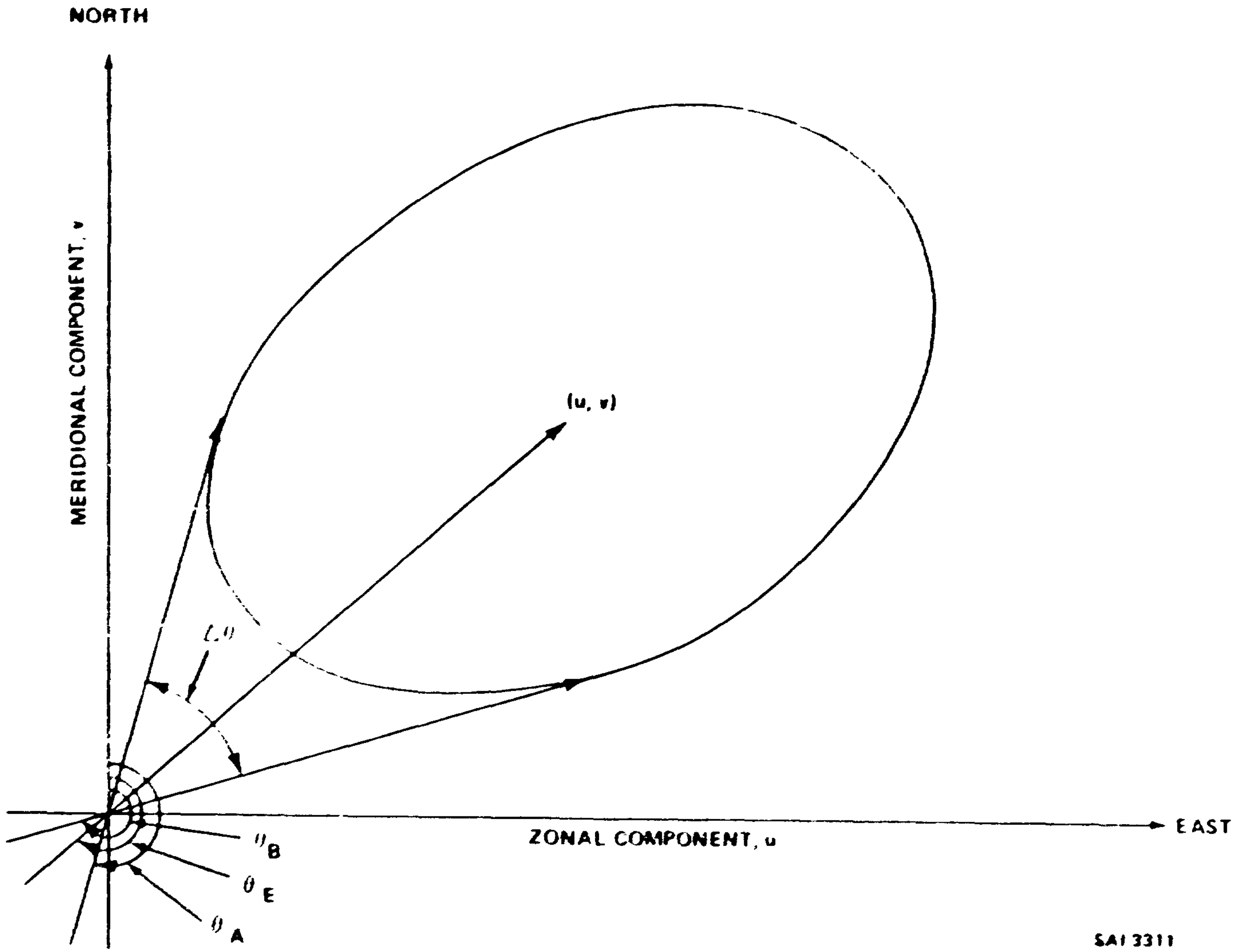

Figure 17. Wind Direction Characteristics of a Vector Probability Ellipse

IV. CONCLUSIONS

The analysis presented in the preceding section for selected months and altitudes illustrates how various theoretical distribution functions can be used for calculation of wind bias change with respect to time at Cape Kennedy, Florida and Vandenberg AFB, California. The calculations can be made by utilization of the statistics given in the appendix for any reference month at 1 km altitude increments from 0 to 27 km. It also has been shown that the techniques originally used to describe wind change observed in unfiltered Rawinsonde profiles can also be applied with equivalent accuracy to describe wind bias change.

The basic underlying assumption for the calculation of the distributions of wind bias change is that the joint distribution of the four variables represented by the components of the wind bias vector at any initial time and after a specified elapsed time is quadravariate normal. If the wind bias vector is specified at an initial time, then the conditional joint distribution of the wind bias components at a future time is bivariate normal. Since each of the variables of the quadravariate normal distribution is normal and the difference of two normal distributions is normal, it follows that wind bias component change is also normal and the joint distribution of zonal and meridional wind bias change is bivariate normal. The modulus of bivariate normally distributed variables has a Rayleigh distribution. Therefore, the modulus of vector wind bias change with respect to time is Rayleigh.

Sample distributions based on reference month Rawinsonde data obtained during January 1965-74 at Vandenberg AFB and April 1956-70 at Cape Kennedy agree reasonably well with the aforementioned theoretical distributions.

The standard deviation of wind bias component change with respect to time is the only statistic required for determination of the theoretical probability distribution (normal with zero mean) of wind bias component change. It has been shown than over a large range of altitudes that this statistic can be estimated from wind bias component standard deviation and the decay constant of the component theoretical autocorrelation function (Table 1). The assumption of exponential decay of the autocorrelation function is reasonably accurate in most instances to time increments as large as 72 hours at both locations.

The observed modulus of vector wind bias change with respect to time is systemmatically larger than the predicted modulus (Section III.C) for extreme probabilities. This may be attributable to inadequacy of the theory or inaccuracies of the data which affect the observed distribution at the extreme probabilities. If the theoretical distribution at extreme probabilities is to be used in engineering applications, it will be necessary to explain these systemmatic differences.

V. REFERENCES

1. Adelfang, S. I.: Analysis of Vector Wind Change with Respect to Time for Cape Kennedy, Florida. Science Applications, Inc., Report SAI-78-552-HU, prepared for NASA-Marshall Space Flight Center under Contract NAS8-32226, 14 April 1977.

2. Adelfang, S. I.: Analysis of Vector Wind Change with Respect to Time for Vandenberg Air Force Base, California. Science Applications, Inc., Report SAI-78-668-HU, prepared for NASA-Marshall Space Flight Center under Contract NAS8-32226, 1 December 1977.

3. Smith, O. E.: Vector Wind and Vector Wind Shear Models 0-27 km Altitude for Cape Kennedy, Florida, and Vandenberg AFB, California. NASA TMX-73319, July 1976.

4. DeMandel, R. E. and Krivo, S. J.: Selecting Digital Filters for Application to Detailed Wind Profiles. NASA CR-61325.

5. Weil, H.: The Distribution of Radial Error. Ann. of Mathematical Statistics, Vol. 25, 1954, pp. 168-170.

6. Yadavalli, S. V.: On Applications of Some Results Related to Bivariate Gaussian Density Distribution Functions. Int. J. of Control. 1st Series, Vol. 5, No. 2, 1967, pp. 191-194.

APPENDIX

This appendix contains two sets of reference month quadravariate and conditional bivariate normal statistics of variables X, Y, XP and YP, at 1 km intervals from 5 to 22 km. The statistics were calculated from serially complete twice daily wind bias profiles calculated from Rawinsonde profiles obtained during the period 1965-74 at VAFB and 1956-70 at KSC. The notation for the variable given in Section II of this report differs from the notation established for the computer output given herein; the notations are compared in Table A-1.

TABLE A-1. NOTATION OF VARIABLES

Computation Set	A		B	
Variable	Text (Sect. II)	Computer Output	Text (Sect. II)	Computer Output
X	u_0	u(at T)	u_0	u(at T)
Y	v_0	v(at T)	v_0	v(at T)
XP	u_1	u(at T+DT)	$u_1 - u_0 = \Delta u$	u(at T+DT) -u(at T)
YP	v_1	v(at T+DT)	$v_1 - v_0 = \Delta v$	v(at T+DT) -v(at T)

Table A-1 shows that the quadravariate statistics of computation set "A" are for wind bias components at an initial time and after a specified time increment; the statistics for set "B" are for wind bias components at an initial time and wind bias component change after a specified time increment. The reference month quadravariate normal statistics at a particular altitude for six time increments (12, 24, 36, 48, 60 and 72 hours) are listed in the lower left of each page of computer listing; the six sets of conditonal bivariate normal statistics corresponding to the six time increments are listed in the lower right. The data were conditioned on monthly means for the entire data sample. The derivation of the conditional bivariate normal statistics for any other given vector involves recalculation of the conditional means according to equations A-1 and A-2; the standard deviations and correlation coefficients do not have to be recalculated because they are independent of the given wind vector.

$$\bar{x}_c | xp^* = \bar{x} + \frac{[(R(x,xp) - R(x,yp)\,R(xp,yp))\,(xp^* - \overline{xp})\,(\sigma_x/\sigma_{xp}) + (R(x,yp) - R(x,xp)\,R(xp,yp))\,(yp^* - yp)\,(\sigma_x/\sigma_{yp})]}{1 - [R(xp,yp)]^2} \qquad \text{(A-1)}$$

$$\bar{y}_c | yp^* = \bar{y} + \frac{[(R(y,xp) - R(y,yp)\,R(xp,yp))\,(xp^* - \overline{xp})\,(\sigma_y/\sigma_{xp}) + (R(y,yp) - R(y,xp)\,R(xp,yp))\,(yp^* - \overline{yp})\,(\sigma_y/\sigma_{yp})]}{1 - [R(xp,yp)]^2} \qquad \text{(A-2)}$$

where, $\bar{x}_c$ and $\bar{y}_c$ are the mean components of the conditional distribution,

xp* and yp* are the components of the given vector and

$\sigma_x, \sigma_y, \sigma_{xp}$ and σ_{yp} are equivalent to S.D.x, S.D.y, S.D.xp and S.D.yp, respectively given in the computer listings.

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 5

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
11.29	9.40	.1510	-1.58	6.34	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	11.21	9.37	.9889	-1.64	6.34	.7646	.1528	.2740	-.0416
24	11.06	9.33	.7499	-1.67	6.33	.5268	.1491	.2656	-.1415
36	10.94	9.28	.6298	-1.70	6.32	.3347	.1449	.2039	-.1735
48	10.83	9.22	.5542	-1.74	6.28	.2069	.1371	.1332	-.1563
60	10.76	9.16	.4938	-1.68	6.25	.1522	.1336	.0753	-.1266
72	10.73	9.13	.4488	-1.65	6.24	.1396	.1290	.0475	-.1075

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
11.29	-1.58

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	11.35	3.96	.1471	-1.53	3.96
24	11.43	5.73	.1543	-1.51	5.26
36	11.47	6.85	.1551	-1.51	5.89
48	11.51	7.50	.1564	-1.52	6.17
60	11.54	7.96	.1694	-1.55	6.26
72	11.54	8.26	.1740	-1.56	6.28

ALTITUDE (KM) - 6

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
14.01	10.38	.1781	-2.00	6.94	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	13.92	10.36	.8954	-2.04	6.94	.7657	.1813	.2786	.0181
24	13.74	10.32	.7689	-2.08	6.93	.5481	.1778	.2632	-.0800
36	13.59	10.28	.6590	-2.11	6.92	.3617	.1724	.2015	-.1287
48	13.45	10.22	.5869	-2.16	6.86	.2386	.1642	.1312	-.1249
60	13.37	10.16	.5226	-2.10	6.83	.1920	.1582	.0729	-.1041
72	13.33	10.11	.4711	-2.07	6.82	.1796	.1537	.0391	-.0869

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
14.01	-2.00

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	14.09	4.36	.1337	-1.96	4.35
24	14.20	6.23	.1787	-1.92	5.69
36	14.27	7.38	.1936	-1.92	6.40
48	14.32	8.07	.2001	-1.93	6.71
60	14.35	8.63	.2142	-1.96	6.81
72	14.34	9.00	.2204	-1.98	6.83

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 7

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
16.81	11.47	.1999	-2.35	7.67	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
16.81	-2.35

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	16.71	11.46	.8972	-2.39	7.67	.7702	.2029	.2831	.0656	16.90	4.88	.1223	-2.31	4.79
24	16.50	11.42	.7775	-2.44	7.65	.5617	.1995	.2639	-.0276	17.04	6.89	.1875	-2.27	6.23
36	16.32	11.38	.6743	-2.47	7.64	.3788	.1934	.2034	-.0841	17.13	8.09	.2141	-2.27	7.03
48	16.16	11.31	.6021	-2.51	7.57	.2636	.1857	.1305	-.0890	17.19	8.85	.2306	-2.27	7.37
60	16.07	11.24	.5371	-2.47	7.55	.2237	.1789	.0692	-.0732	17.21	9.47	.2482	-2.31	7.47
72	16.01	11.18	.4823	-2.47	7.54	.2089	.1745	.0290	-.0645	17.21	9.90	.2573	-2.34	7.50

ALTITUDE (KM) - 8

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
19.73	12.67	.2223	-2.75	8.59	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
19.73	-2.75

DT HR	MEAN XP	S.D. YP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	19.61	12.65	.8966	-2.79	8.59	.7752	.2246	.2891	.1060	19.83	5.47	.1284	-2.71	5.33
24	19.37	12.61	.7809	-2.84	8.56	.5689	.2214	.2669	.0208	20.00	7.66	.1948	-2.67	6.95
36	19.16	12.57	.6808	-2.87	8.54	.3909	.2156	.2067	-.0358	20.10	8.97	.2268	-2.66	7.83
48	18.99	12.50	.6059	-2.92	8.46	.2880	.2086	.1317	-.0470	20.16	9.83	.2550	-2.67	8.21
60	18.88	12.42	.5413	-2.89	8.45	.2432	.2019	.0655	-.0375	20.19	10.48	.2767	-2.71	8.33
72	18.81	12.34	.4859	-2.85	8.44	.2239	.1972	.0176	-.0359	20.19	10.94	.2899	-2.75	8.37

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 9

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
22.77	13.92	.2444	-3.22	9.70	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	22.64	13.89	.8972	-3.27	9.71	.7783	.2456	.2935	.1422
24	22.38	13.84	.7846	-3.32	9.67	.5730	.2430	.2480	.0672
36	22.15	13.80	.6845	-3.35	9.64	.4021	.2378	.2078	.0147
48	21.95	13.73	.6070	-3.40	9.54	.3020	.2314	.1318	-.0003
60	21.83	13.63	.5433	-3.38	9.55	.2529	.2248	.0512	.0003
72	21.74	13.54	.4883	-3.35	9.54	.2287	.2191	.0068	-.0024

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
22.77	-3.22

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
22.89	6.04	.1481	-3.18	6.00
23.08	8.45	.2054	-3.13	7.84
23.19	9.92	.2433	-3.12	8.81
23.27	10.88	.2755	-3.13	9.22
23.29	11.56	.3011	-3.18	9.38
23.29	12.05	.3175	-3.22	9.43

ALTITUDE (KM) - 10

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
25.83	15.70	.2652	-3.71	10.84	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	25.68	14.96	.9016	-3.77	10.86	.7831	.2654	.2967	.1781
24	25.39	14.91	.7922	-3.83	10.81	.5811	.2632	.2663	.1123
36	25.15	14.86	.6919	-3.87	10.76	.4166	.2590	.2049	.0641
48	24.93	14.79	.6141	-3.92	10.67	.3190	.2525	.1292	.0459
60	24.80	14.67	.5501	-3.91	10.69	.2589	.2457	.0580	.0369
72	24.69	14.56	.4949	-3.88	10.67	.2287	.2386	.0007	.0319

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
25.83	-3.71

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
25.96	6.42	.1675	-3.65	6.66
26.17	9.03	.2208	-3.61	8.79
26.30	10.68	.2615	-3.60	9.79
26.38	11.72	.2965	-3.61	10.26
26.41	12.44	.3233	-3.66	10.47
26.42	12.97	.3401	-3.72	10.53

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT I)
Y = V(AT I)
XP = U(AT I + DT)
YP = V(AT I + DT)

ALTITUDE (KM) - 11

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
28.56	15.62	.2846	-4.12	11.67	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	28.39	15.57	.9098	-4.20	11.71	.7948	.2835	.3005	.2124
24	28.08	15.51	.8052	-4.27	11.67	.5978	.2814	.2655	.1530
36	27.82	15.46	.7061	-4.32	11.61	.4767	.2778	.2032	.1066
48	27.60	15.38	.6294	-4.37	11.52	.3373	.2712	.1280	.0847
60	27.45	15.25	.5642	-4.37	11.59	.2679	.2641	.0589	.0684
72	27.33	15.14	.5082	-4.34	11.52	.2305	.2557	.0029	.0626

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
28.56	-4.12

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
28.71	6.44	.1867	-4.05	7.02
28.94	9.19	.2407	-4.00	9.28
29.08	10.97	.2833	-3.99	10.45
29.16	12.06	.3196	-4.01	10.79
29.20	12.83	.3457	-4.06	11.25
29.20	13.41	.3597	-4.12	11.34

ALTITUDE (KM) - 12

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
30.44	15.56	.3020	-4.35	11.72	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	30.26	15.57	.9194	-4.44	11.77	.8142	.2997	.3767	.2413
24	29.94	15.47	.8206	-4.53	11.94	.6240	.2979	.2489	.1872
36	29.68	15.37	.7235	-4.59	11.83	.4629	.2949	.2764	.1387
48	29.46	15.30	.6484	-4.65	11.81	.3586	.2883	.1321	.1171
60	29.31	15.17	.5822	-4.65	11.82	.2819	.2813	.0663	[illegible]
72	29.16	[illegible]	.5287	[illegible]	[illegible]	.2768	.2725	.0122	[illegible]

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
30.44	-4.35

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
30.61	4.92	.2053	-4.27	6.88
30.85	8.84	.2643	-4.21	9.26
30.99	10.47	.3063	-4.20	10.53
31.08	11.78	.3428	-4.22	11.17
31.11	12.66	.3647	-4.27	11.44
31.12	13.21	.3795	-4.33	11.57

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 12

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
30.97	14.77	.3193	-4.33	11.46	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	30.77	14.70	.9276	-4.43	11.53	.8371	.3161	.3206	.2641
24	30.47	14.63	.8349	-4.53	11.50	.6551	.3149	.2830	.2088
36	30.20	14.56	.7398	-4.60	11.46	.4927	.3131	.2700	.1613
48	30.09	14.49	.6665	-4.67	11.40	.3913	.3069	.1471	.1320
60	29.85	14.36	.5990	-4.68	11.41	.2980	.3006	.0843	.1149
72	29.73	14.24	.5395	-4.67	11.39	.2456	.2924	.0319	.1059

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
30.97	-4.33

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
31.15	5.50	.2255	-4.24	6.24
31.39	8.08	.2846	-4.17	8.61
31.53	9.88	.3268	-4.16	9.98
31.62	10.95	.3622	-4.18	10.59
31.65	11.78	.3786	-4.23	10.94
31.66	12.41	.3878	-4.29	11.10

ALTITUDE (KM) - 14

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
29.76	13.38	.3356	-4.07	10.4[illegible]	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	29.56	13.30	.9316	-4.17	10.46	.8573	.3324	.3434	.2796
24	29.28	13.24	.8449	-4.27	10.45	.6841	.3327	.3107	.2226
36	29.03	13.16	.7515	-4.35	10.41	.5202	.3333	.2476	.1745
48	28.84	13.09	.6795	-4.42	10.37	.4010	.3282	.1764	.1473
60	28.71	12.98	.6108	-4.43	10.38	.3114	.3231	.1147	.1273
72	28.59	12.86	.5494	-4.43	10.36	.2526	.3162	.0723	.1159

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
29.76	-4.07

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
29.95	4.85	.2205	-3.98	5.31
30.17	7.11	.2893	-3.91	7.53
30.31	8.76	.3358	-3.89	8.84
30.39	9.75	.3702	-3.90	9.51
30.42	10.55	.3834	-3.95	9.88
30.43	11.15	.3925	-4.00	10.06

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION 12868 - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1956 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 15

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
26.76	11.68	.3990	-3.62	8.97	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	26.66	11.59	.9370	-3.71	9.03	.8695	.3970	.3756	.2869
24	26.33	11.54	.8499	-3.80	9.03	.7017	.3502	.3721	.2279
36	26.09	11.49	.7584	-3.88	9.02	.5369	.3541	.2907	.1892
48	25.92	11.39	.6871	-3.94	8.97	.4112	.3512	.2211	.1473
60	25.80	11.28	.6166	-3.96	8.94	.3160	.3475	.1583	.1379
72	25.69	11.17	.5590	-3.96	8.97	.2517	.3421	.1044	.1206

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
26.76	-3.67

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
26.90	4.26	.1091	-3.54	4.38
27.10	6.09	.2620	-3.46	6.31
27.27	7.53	.3196	-3.44	7.57
27.34	8.41	.3565	-3.44	8.14
27.37	9.14	.3718	-3.48	8.49
27.38	9.69	.3839	-3.52	8.69

ALTITUDE (KM) - 16

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
22.37	9.96	.[illegible]	-3.07	7.45	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	22.11	9.85	.9237	-3.14	7.56	.8711	.3592	.4763	.2858
24	21.90	9.83	.8485	-3.21	7.59	.7029	.3659	.4107	.2271
36	21.71	9.73	.7587	-3.28	7.47	.5571	.3730	.3459	.1822
48	21.55	9.68	.6872	-3.34	7.44	.4986	.3735	.2787	.1717
60	21.45	9.58	.6155	-3.36	7.45	.3307	.3775	.2145	.[illegible]
72	21.36	9.48	.5547	-3.36	7.45	.2468	.3661	.1797	.[illegible]

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
22.30	-3.07

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
22.47	3.79	.1167	-3.00	3.58
22.64	5.20	.1982	-2.93	5.17
22.76	6.40	.2651	-2.89	6.17
22.82	7.15	.3116	-2.89	6.72
22.86	7.79	.3594	-2.92	7.03
22.87	8.25	.3575	-2.96	7.21

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 17

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
17.03	8.42	.3626	-2.51	6.01	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
17.03	-2.51

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (YP,X)	R (XP,Y)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	16.86	8.32	.9128	-2.56	6.05	.8452	.3675	.4793	.2801	17.19	3.40	.0577	-2.45	2.92
24	16.69	8.26	.8398	-2.61	6.04	.6895	.3777	.4474	.2255	17.32	4.49	.1145	-2.39	4.19
36	16.52	8.23	.7519	-2.67	6.01	.5209	.3868	.4051	.1857	17.42	5.47	.1921	-2.35	4.96
48	16.39	8.15	.6793	-2.71	5.99	.3917	.3899	.3406	.1576	17.48	6.10	.2511	-2.34	5.39
60	16.30	8.07	.6098	-2.73	5.99	.2936	.3864	.2795	.1439	17.49	6.62	.2877	-2.35	5.69
72	16.22	7.98	.5513	-2.73	6.00	.2214	.3820	.2246	.1309	17.50	6.98	.3145	-2.37	5.79

ALTITUDE (KM) - 18

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
11.69	7.10	.7652	-2.00	4.75	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
11.69	-2.00

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (YP,X)	R (XP,Y)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	11.55	7.02	.8771	-2.04	4.77	.8515	.3731	.4528	.2776	11.82	3.08	.0180	-1.96	2.39
24	11.41	6.97	.8283	-2.07	4.77	.6460	.3857	.4805	.2259	11.93	3.91	.0510	-1.91	3.35
36	11.28	6.91	.7417	-2.11	4.73	.4921	.3950	.4544	.1951	12.00	4.70	.1191	-1.87	3.91
48	11.16	6.87	.6676	-2.14	4.71	.3648	.3994	.3936	.1743	12.04	5.24	.1906	-1.86	4.23
60	11.08	6.81	.5989	-2.16	4.73	.2676	.3943	.3428	.1597	12.07	5.66	.2324	-1.86	4.41
72	11.02	6.73	.5468	-2.16	4.71	.1987	.3887	.2907	.1455	12.08	5.93	.2681	-1.87	4.53

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 19

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
6.93	6.00	.3607	-1.58	3.74	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	6.81	5.93	.9869	-1.60	3.74	.8159	.3695	.4502	.2781
24	6.70	5.90	.8199	-1.62	3.74	.6315	.3831	.4809	.2251
36	6.60	5.85	.7360	-1.65	3.70	.4443	.3907	.4694	.2046
48	6.51	5.81	.6607	-1.67	3.67	.3321	.3953	.4197	.1854
60	6.44	5.76	.5906	-1.68	3.66	.2267	.3884	.3793	.1770
72	6.39	5.70	.5412	-1.68	3.66	.1711	.3821	.3334	.1581

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
6.93	-1.58

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
7.03	2.75	-.0047	-1.55	2.08
7.12	3.38	.0319	-1.52	2.73
7.18	4.02	.0727	-1.49	3.12
7.22	4.47	.1531	-1.47	3.33
7.23	4.83	.1910	-1.46	3.44
7.24	5.03	.2313	-1.47	3.52

ALTITUDE (KM) - 20

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
3.10	5.09	.3274	-1.26	3.01	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	3.02	5.05	.8808	-1.27	3.01	.7453	.3341	.3974	.2598
24	2.93	5.03	.8163	-1.28	3.00	.5881	.3457	.4197	.2068
36	2.86	4.99	.7335	-1.30	2.96	.3750	.3509	.4151	.1945
48	2.78	4.95	.6527	-1.30	2.94	.2999	.3542	.3783	.1705
60	2.73	4.92	.5769	-1.31	2.92	.1632	.3462	.3545	.1677
72	2.69	4.88	.5218	-1.30	2.92	.1300	.3409	.3184	.1411

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
3.10	-1.26

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
3.17	2.40	.0036	-1.24	1.95
3.25	2.91	.0512	-1.22	2.33
3.28	3.44	.0664	-1.20	2.64
3.31	3.84	.1341	-1.19	2.74
3.32	4.16	.1631	-1.18	2.81
3.32	4.34	.2008	-1.18	2.85

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/58 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 21

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
.36	4.48	.2572	-1.02	2.55	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.30	4.46	.8795	-1.03	2.54	.6653	.2599	.2833	.2140
24	.23	4.44	.8127	-1.03	2.53	.5497	.2660	.2980	.1730
36	.18	4.41	.7263	-1.04	2.51	.3022	.2689	.2823	.1624
48	.13	4.38	.6331	-1.03	2.48	.2646	.2698	.2756	.1375
60	.10	4.36	.5497	-1.03	2.47	.0741	.2644	.2498	.1278
72	.06	4.33	.4796	-1.02	2.47	.0589	.2614	.2292	.0955

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
.36	-1.02

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
.41	2.13	.0492	-1.01	1.88
.47	2.60	.0774	-1.00	2.09
.49	3.07	.0941	-.99	2.37
.51	3.46	.1231	-.99	2.40
.51	3.74	.1484	-.98	2.47
.51	3.93	.1725	-.98	2.48

ALTITUDE (KM) - 22

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
-1.35	4.22	.1898	-.88	2.28	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-1.46	4.21	.8749	-.88	2.27	.6235	.1089	.1634	.1720
24	-1.45	4.20	.8075	-.87	2.27	.5250	.1907	.1748	.1602
36	-1.49	4.18	.7095	-.87	2.25	.2582	.1924	.1724	.1486
48	-1.52	4.15	.6079	-.85	2.22	.2127	.1907	.1456	.1282
60	-1.54	4.14	.5121	-.85	2.22	-.0131	.1911	.1072	.0910
72	-1.56	4.11	.4291	-.83	2.21	-.0308	.1896	.1066	.0537

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
-1.35	-.88

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
-1.31	2.04	.1104	-.87	1.78
-1.27	2.49	.0904	-.88	1.94
-1.26	2.97	.1357	-.87	2.20
-1.25	3.35	.1270	-.87	2.22
-1.25	3.62	.1567	-.86	2.27
-1.26	3.81	.1580	-.86	2.27

B I V A R I A T E   N O R M A L   S T A T I S T I C S   O F   X, Y

STATION (12868) - CAPE KENNEDY

X = U(AT T)
Y = V(AT T)

MONTH	PER. OF REC.	ALT KM.	ALPHA DEG.	MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
4	1/56 - 12/70	5	90.0	11.29	9.40	.1510	-1.58	6.34	900
4	1/56 - 12/70	6	90.0	14.01	10.78	.1781	-2.00	6.24	900
4	1/56 - 12/70	7	90.0	16.81	11.47	.1999	-2.35	7.67	900
4	1/56 - 12/70	8	90.0	19.73	12.67	.2273	-2.75	8.59	900
4	1/56 - 12/70	9	90.0	22.77	13.92	.2444	-3.22	9.70	900
4	1/56 - 12/70	10	90.0	25.83	15.00	.2652	-3.71	10.84	900
4	1/56 - 12/70	11	90.0	28.56	15.62	.2846	-4.12	11.67	900
4	1/56 - 12/70	12	90.0	30.44	15.56	.3020	-4.35	11.92	900
4	1/56 - 12/70	13	90.0	30.97	14.77	.3193	-4.33	11.46	900
4	1/56 - 12/70	14	90.0	29.76	13.38	.3356	-4.07	10.40	900
4	1/56 - 12/70	15	90.0	26.76	11.68	.3490	-3.62	8.97	900
4	1/56 - 12/70	16	90.0	22.30	9.96	.3583	-3.07	7.45	900
4	1/56 - 12/70	17	90.0	17.03	8.42	.3626	-2.51	6.01	900
4	1/56 - 12/70	18	90.0	11.69	7.10	.3652	-2.00	4.75	900
4	1/56 - 12/70	19	90.0	6.93	6.00	.3607	-1.58	3.74	900
4	1/56 - 12/70	20	90.0	3.10	5.09	.3274	-1.26	3.01	900
4	1/56 - 12/70	21	90.0	.36	4.48	.2572	-1.02	2.55	900
4	1/56 - 12/70	22	90.0	-1.35	4.22	.1888	-.88	2.28	900

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 5

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
11.29	9.40	.1510	-1.58	6.34	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.08	4.42	-.2405	-.05	4.35	-.3433	.2218	.2599	-.2807
24	-.23	6.62	-.3622	-.09	6.16	-.4884	.2571	.1601	-.3006
36	-.35	8.04	-.4418	-.12	7.31	-.5787	.2692	.0590	-.2813
48	-.46	8.79	-.4875	-.15	7.95	-.6346	.2628	-.0216	-.2439
60	-.53	9.36	-.5214	-.10	8.20	-.6580	.2573	-.0780	-.2133
72	-.56	9.73	-.5447	-.07	8.25	-.6633	.2441	-.1012	-.1935

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
11.29	-1.58

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	7.55	8.85	.1428	5.12	5.54
24	6.81	8.52	.1226	2.66	5.21
36	6.25	8.28	.1056	1.36	4.98
48	5.79	8.13	.0948	.51	4.81
60	5.49	7.98	.0886	-.02	4.76
72	5.34	7.86	.0878	-.30	4.73

ALTITUDE (KM) - 6

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
14.01	10.38	.1781	-2.00	6.94	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.09	4.74	-.2313	-.05	4.75	-.3418	.2007	.2191	-.2337
24	-.27	7.04	-.3466	-.08	6.59	-.4772	.2679	.1236	-.2716
36	-.42	8.53	-.4223	-.12	7.83	-.5670	.2986	.0262	-.2715
48	-.56	9.36	-.4681	-.16	8.52	-.6228	.3002	-.0543	-.2458
60	-.65	10.03	-.5052	-.11	8.76	-.6430	.2965	-.1104	-.2225
72	-.69	10.54	-.5330	-.07	8.82	-.6483	.2889	-.1379	-.2075

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
14.01	-2.00

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	8.92	9.90	.1803	5.34	6.20
24	8.38	9.54	.1590	2.93	5.83
36	7.83	9.27	.1366	1.58	5.54
48	7.27	9.10	.1223	.58	5.34
60	6.89	8.92	.1126	-.10	5.28
72	6.67	8.76	.1078	-.47	5.27

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 7

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
16.81	11.47	.1999	-2.35	7.67	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.10	5.20	-.2286	-.04	5.20	-.3382	.1767	.1831	-.1980
24	-.31	7.64	-.3395	-.08	7.17	-.4704	.2614	.0945	-.2432
36	-.50	9.22	-.4119	-.11	8.53	-.5598	.3051	.0023	-.2549
48	-.66	10.16	-.4588	-.16	9.25	-.6138	.3180	-.0804	-.2386
60	-.75	10.93	-.4971	-.11	9.48	-.6309	.3197	-.1386	-.2200
72	-.80	11.53	-.5275	-.08	9.56	-.6373	.3208	-.1707	-.2110

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
16.81	-2.35

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
10.18	11.01	.2081	5.21	6.97
9.80	10.63	.1895	2.95	6.54
9.31	10.34	.1660	1.64	6.20
8.70	10.13	.1485	.52	5.98
8.24	9.93	.1362	-.30	5.93
7.96	9.73	.1265	-.73	5.90

ALTITUDE (KM) - 8

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
19.73	12.67	.2223	-2.75	8.59	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.12	5.76	-.2302	-.04	5.76	-.3343	.1704	.1461	-.1733
24	-.35	8.37	[illegible]	-.08	7.96	-.4669	.2540	.0656	-.2174
36	-.56	10.08	-.4079	-.12	9.45	-.5552	.3029	-.0716	-.2343
48	-.74	11.17	-.4562	-.17	10.20	-.6064	.3259	-.1047	-.2262
60	-.84	12.02	-.4950	-.13	10.48	-.6233	.3367	-.1667	-.2124
72	-.91	12.68	-.5263	-.10	10.61	-.6314	.3471	-.2049	-.2085

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
19.73	-2.75

MEAN XP	S.D. YP	R (XP,YP)	MEAN YP	S.D. YP
11.52	12.21	.2329	4.93	7.90
11.15	11.80	.2193	2.79	7.42
10.70	11.47	.1982	1.48	7.02
10.07	11.23	.1787	.27	6.78
9.53	10.99	.1633	-.67	6.70
9.18	10.77	.1487	-1.16	6.66

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 9

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
22.77	13.92	.2444	-3.22	9.70	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.13	6.30	-.2313	-.05	6.46	-.3313	.1807	.1071	-.1532
24	-.40	9.11	-.3360	-.10	8.95	-.4646	.2514	.0336	-.1923
36	-.62	11.01	-.4066	-.13	10.57	-.5509	.2993	-.0486	-.2108
48	-.82	12.26	-.4560	-.18	11.37	-.5995	.3287	-.1300	-.2087
60	-.94	13.17	-.4949	-.16	11.76	-.6191	.3494	-.1951	-.2013
72	-1.03	13.89	-.5262	-.12	11.95	-.6292	.3659	-.2383	-.2003

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
22.77	-3.22

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12.92	13.45	.2551	4.58	9.00
12.46	13.02	.2469	2.45	8.45
12.01	12.65	.2294	1.08	8.01
11.38	12.36	.2097	-.20	7.73
10.76	12.09	.1908	-1.22	7.61
10.33	11.84	.1727	-1.80	7.54

ALTITUDE (KM) - 10

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
25.83	15.00	.2852	-3.71	10.84	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.15	6.65	-.2280	-.06	7.14	-.3265	.1921	.0691	-.1316
24	-.44	9.64	-.3316	-.12	9.91	-.4595	.2545	-.0011	-.1675
36	-.68	11.72	-.4029	-.16	11.67	-.5444	.3012	-.0797	-.1872
48	-.90	13.09	-.4526	-.21	12.55	-.5921	.3343	-.1580	-.1900
60	-1.04	14.08	-.4925	-.20	13.10	-.6160	.3606	-.2222	-.1893
72	-1.14	14.86	-.5244	-.17	13.36	-.6286	.3777	-.2670	-.1897

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
25.83	-3.71

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
14.18	14.55	.2756	4.04	10.14
13.68	14.09	.2710	1.88	9.54
13.23	13.69	.2567	.45	9.04
12.59	13.36	.2375	-.88	8.72
11.92	13.06	.2167	-1.93	8.54
11.42	12.77	.1970	-2.62	8.42

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP
STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 11

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
28.56	15.62	.2846	-4.12	11.67	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
28.56	-4.12

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	-.17	6.62	-.2201	-.08	7.49	-.3159	.2039	.0351	-.1115	15.19	15.20	.2939	3.26	11.01
24	-.48	9.72	-.3229	-.15	10.47	-.4490	.2643	-.0339	-.1469	14.69	14.75	.2912	1.15	10.38
36	-.73	11.92	-.3952	-.20	12.36	-.5344	.3106	-.1094	-.1686	14.24	14.33	.2791	-.27	9.84
48	-.96	13.35	-.4450	-.25	13.35	-.5832	.3463	-.1855	-.1757	13.59	13.99	.2603	-1.64	9.48
60	-1.11	14.42	-.4867	-.25	14.04	-.6111	.3727	-.2460	-.1800	12.89	13.65	.2397	-2.69	9.24
72	-1.23	15.26	-.5197	-.22	14.39	-.6269	.3863	-.2891	-.1807	12.33	13.34	.2206	-3.46	9.08

ALTITUDE (KM) - 12

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
30.44	15.56	.3020	-4.35	11.92	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
30.44	-4.35

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	-.19	6.23	-.2103	-.09	7.28	-.2985	.2209	.0085	-.0978	15.77	15.19	.3097	2.44	11.34
24	-.50	9.28	-.3121	-.18	10.35	-.4323	.2816	-.0593	-.1343	15.31	14.76	.3077	.51	10.72
36	-.76	11.50	-.3856	-.24	12.34	-.5205	.3272	-.1327	-.1583	14.85	14.35	.2972	-.86	10.17
48	-.98	12.94	-.4358	-.30	13.44	-.5721	.3636	-.2071	-.1686	14.19	14.00	.2791	-2.26	9.78
60	-1.14	14.05	-.4789	-.31	14.23	-.6036	.3852	-.2629	-.1741	13.47	13.66	.2606	-3.31	9.50
72	-1.26	14.92	-.5136	-.28	14.65	-.6229	.3941	-.3025	-.1755	12.92	13.34	.2433	-4.09	9.30

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 13

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
30.97	14.77	.3193	-4.33	11.46	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.20	5.61	-.2024	-.10	6.56	-.2768	.2344	-.0006	-.0939
24	-.50	8.45	-.3019	-.20	9.54	-.4119	.2993	-.0680	-.1320
36	-.76	10.58	-.3773	-.27	11.54	-.5041	.3460	-.1428	-.1570
48	-.97	11.95	-.4278	-.34	12.72	-.5598	.3824	-.2162	-.1696
60	-1.12	13.05	-.4723	-.35	13.55	-.5950	.3963	-.2686	-.1733
72	-1.24	13.92	-.5088	-.33	14.03	-.6177	.4017	-.3059	-.1753

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
30.97	-4.33

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
15.77	14.44	.3259	2.17	10.99
15.41	14.06	.3243	.40	10.43
14.87	13.67	.3152	-1.01	9.89
14.22	13.35	.2983	-2.40	9.50
13.51	13.01	.2833	-3.48	9.20
12.97	12.70	.2681	-4.23	8.99

ALTITUDE (KM) - 14

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
29.76	13.38	.3356	-4.07	10.40	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.20	4.94	-.2008	-.10	5.57	-.2562	.2296	.0155	-.1013
24	-.48	7.42	-.2956	-.20	8.28	-.3918	.3064	-.0507	-.1403
36	-.73	9.36	-.3728	-.27	10.19	-.4884	.3583	-.1317	-.1640
48	-.92	10.60	-.4232	-.35	11.37	-.5487	.3942	-.2058	-.1771
60	-1.06	11.63	-.4690	-.36	12.19	-.5874	.4027	-.2582	-.1780
72	-1.17	12.46	-.5071	-.35	12.69	-.6129	.4074	-.2961	-.1803

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
29.76	-4.07

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
15.10	13.09	.3434	2.91	10.02
14.89	12.77	.3429	1.19	9.53
14.23	12.41	.3356	-.43	9.06
13.61	12.12	.3207	-1.81	8.69
12.90	11.82	.3091	-2.96	8.41
12.37	11.53	.2959	-3.72	8.20

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 15

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
26.76	11.68	.3690	-3.62	8.97	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
26.76	-3.62

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	-.20	4.34	-.2070	-.09	4.60	-.2429	.1918	.0583	-.1182	13.62	11.39	.3621	4.25	8.65
24	-.45	6.36	-.2951	-.18	6.95	-.3789	.2857	-.0025	-.1550	13.56	11.13	.3647	2.62	8.24
36	-.67	8.04	-.3725	-.25	8.64	-.4786	.3489	-.0931	-.1746	12.85	10.83	.3599	.73	7.84
48	-.84	9.13	-.4226	-.32	9.73	-.5427	.3874	-.1709	-.1859	12.29	10.58	.3479	-.66	7.52
60	-.96	10.06	-.4696	-.34	10.49	-.5840	.3960	-.2278	-.1846	11.62	10.31	.3389	-1.88	7.28
72	-1.07	10.80	-.5087	-.34	10.97	-.6116	.4030	-.2696	-.1867	11.11	10.06	.3275	-2.65	7.09

ALTITUDE (KM) - 16

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
22.30	9.96	.3583	-3.07	7.45	900

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
22.30	-3.07

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	-.19	3.87	-.2200	-.07	3.79	-.2414	.1332	.1131	-.1384	11.31	9.66	.3814	4.86	7.14
24	-.40	5.45	-.3016	-.14	5.76	-.3779	.2310	.0664	-.1676	11.31	9.45	.3903	3.54	6.79
36	-.60	6.84	-.3770	-.21	7.18	-.4788	.3067	-.0297	-.1822	10.78	9.20	.3893	1.69	6.47
48	-.75	7.77	-.4265	-.27	8.10	-.5443	.3531	-.1129	-.1706	10.33	9.00	.3807	.42	6.22
60	-.85	8.57	-.4739	-.29	8.75	-.5868	.3680	-.1766	-.1887	9.77	8.77	.3735	-.72	6.02
72	-.95	9.19	-.5125	-.29	9.18	-.6157	.3792	-.2236	-.1902	9.33	8.56	.3639	-1.45	5.87

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 17

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
17.03	8.42	.3626	-2.51	6.01	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.17	3.50	-.2353	-.05	3.13	-.2491	.0784	.1606	-.1552
24	-.34	4.72	-.3126	-.10	4.75	-.3879	.1567	.1368	-.1718
36	-.51	5.85	-.3850	-.16	5.88	-.4892	.2332	.0460	-.1803
48	-.64	6.64	-.4343	-.20	6.62	-.5541	.2877	-.0417	-.1850
60	-.73	7.30	-.4804	-.22	7.13	-.5960	.3114	-.1092	-.1846
72	-.81	7.78	-.5167	-.23	7.49	-.6248	.3303	-.1620	-.1860

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
17.03	-2.51

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
8.64	8.10	.3980	4.09	5.72
8.50	7.93	.4175	3.25	5.41
8.21	7.73	.4226	1.81	5.15
7.91	7.56	.4177	.79	4.95
7.54	7.38	.4118	-.07	4.80
7.20	7.20	.4033	-.65	4.68

ALTITUDE (KM) - 18

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
11.69	7.10	.3652	-2.00	4.75	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.14	3.17	-.2496	-.03	2.60	-.2654	.0317	.1842	-.1582
24	-.28	4.13	-.3224	-.06	3.89	-.4051	.0978	.1833	-.1690
36	-.41	5.04	-.3920	-.11	4.78	-.5071	.1562	.1086	-.1699
48	-.53	5.70	-.4417	-.14	5.33	-.5696	.2163	.0192	-.1720
60	-.61	6.24	-.4856	-.16	5.72	-.6107	.2388	-.0419	-.1719
72	-.68	6.59	-.5190	-.16	5.99	-.6373	.2654	-.0966	-.1753

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
11.69	-2.00

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
6.03	6.80	.4101	2.43	4.49
5.82	6.65	.4404	2.11	4.21
5.62	6.49	.4550	1.20	4.00
5.43	6.35	.4532	.52	3.84
5.22	6.20	.4517	.01	3.73
5.01	6.07	.4433	-.35	3.65

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP
STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 19

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
6.93	6.00	.3607	-1.58	3.74	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.11	2.84	-.2588	-.02	2.27	-.3006	.0104	.1790	-.1352
24	-.23	3.57	-.3256	-.04	3.21	-.4292	.0772	.1882	-.1580
36	-.32	4.31	-.3928	-.07	3.92	-.5342	.1030	.1353	-.1509
48	-.42	4.86	-.4438	-.08	4.28	-.5879	.1647	.0505	-.1558
60	-.49	5.32	-.4870	-.10	4.60	-.6321	.1724	.0043	-.1523
72	-.54	5.61	-.5189	-.10	4.76	-.6529	.2053	-.0467	-.1614

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
6.93	-1.58

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
3.64	5.74	.4097	.88	3.50
3.52	5.61	.4426	.89	3.27
3.33	5.47	.4692	.43	3.08
3.21	5.35	.4687	.07	2.97
3.10	5.22	.4770	-.19	2.86
2.98	5.11	.4670	-.35	2.81

ALTITUDE (KM) - 20

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
3.10	5.09	.3274	-1.26	3.01	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.08	2.48	-.2594	-.01	2.15	-.3581	.0136	.1375	-.0951
24	-.17	3.07	-.3224	-.02	2.73	-.4575	.0861	.1443	-.1341
36	-.24	3.68	-.3892	-.04	3.34	-.5687	.0843	.1097	-.1225
48	-.31	4.19	-.4438	-.04	3.52	-.6051	.1344	.0494	-.1378
60	-.37	4.61	-.4883	-.05	3.84	-.6601	.1271	.0171	-.1291
72	-.41	4.88	-.5221	-.05	3.91	-.6724	.1625	-.0234	-.1466

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
3.10	-1.26

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
1.68	4.90	.3721	-.08	2.78
1.65	4.79	.3954	-.01	2.62
1.50	4.67	.4295	-.18	2.43
1.44	4.55	.4289	-.28	2.36
1.37	4.43	.4488	-.38	2.24
1.33	4.33	.4363	-.42	2.21

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (12868) - CAPE KENNEDY
MONTH OF RECORD - APRIL
PERIOD OF RECORD - 1/56 - 12/70
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 21

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
.36	4.48	.2572	-1.02	2.55	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.06	2.19	-.2537	-.01	2.08	-.4128	.0492	.0508	-.0539
24	-.13	2.73	-.3181	-.01	2.41	-.5803	.0899	.0630	-.0904
36	-.18	3.29	-.3874	-.02	2.99	-.6004	.0928	.0284	-.0834
48	-.23	3.80	-.4488	-.01	3.05	-.6207	.1091	.0147	-.1032
60	-.26	4.20	-.4952	-.01	3.42	-.6927	.1112	-.0146	-.0995
72	-.29	4.50	-.5337	.00	3.44	-.6982	.1385	-.0353	-.1221

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
.36	-1.02

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
.23	4.33	.2882	-.47	2.32
.22	4.24	.2999	-.45	2.22
.15	4.12	.3269	-.47	2.03
.13	3.99	.3302	-.46	1.99
.09	3.89	.3510	-.47	1.83
.08	3.78	.3395	-.46	1.82

ALTITUDE (KM) - 22

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
-1.35	4.22	.1888	-.88	2.28	900

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	-.04	2.11	-.2523	-.01	1.98	-.4384	.0975	-.0513	-.0204
24	-.10	2.61	-.3167	.00	2.22	-.4926	.0750	-.0252	-.0307
36	-.13	3.20	-.3922	.00	2.76	-.6172	.1080	-.0762	-.0352
48	-.16	3.71	-.4571	.02	2.93	-.6409	.0951	-.0518	-.0519
60	-.19	4.13	-.5087	.02	3.21	-.7219	.1292	-.0856	-.0717
72	-.21	4.45	-.5507	.05	3.23	-.7283	.1421	-.0804	-.0968

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
-1.35	-.88

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
-.70	4.08	.2044	-.42	2.05
-.70	4.00	.2149	-.44	1.99
-.73	3.88	.2257	-.42	1.80
-.73	3.75	.2340	-.42	1.75
-.74	3.63	.2367	-.42	1.58
-.74	3.52	.2292	-.41	1.56

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/79
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 5

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
10.74	10.65	.2638	-3.63	10.64	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	10.83	10.54	.8373	-3.59	10.56	.7497	.2564	.3319	.0975
24	10.89	10.37	.6472	-3.52	10.49	.4817	.2529	.3177	.0231
36	10.97	10.30	.5165	-3.53	10.52	.3126	.2427	.2832	.0024
48	10.93	10.31	.4224	-3.46	10.45	.2281	.2521	.2908	-.0040
60	10.82	10.35	.3523	-3.37	10.41	.1987	.2570	.3096	.0104
72	10.69	10.39	.2689	-3.28	10.42	.1757	.2499	.2807	.0388

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
10.74	-3.63

DT HR	MEAN XP	S.D XP	R (XP,YP)	MEAN YP	S.D. YP
12	10.67	5.68	.2023	-3.67	6.87
24	10.65	7.97	.1856	-3.71	9.07
36	10.62	9.02	.1905	-3.71	9.89
48	10.67	9.57	.1877	-3.71	10.03
60	10.74	9.93	.1876	-3.68	10.03
72	10.77	10.25	.2087	-3.65	10.14

ALTITUDE (KM) - 6

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
12.85	12.22	.2728	-3.90	11.67	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	12.95	12.17	.8365	-3.84	11.73	.7317	.2696	.3269	.1162
24	13.04	11.93	.6483	-3.77	11.70	.4627	.2632	.3057	.0319
36	13.11	11.90	.5147	-3.77	11.72	.2910	.2532	.2681	-.0082
48	13.07	11.85	.4224	-3.68	11.64	.2080	.2623	.2748	-.0142
60	12.95	11.89	.3501	-3.59	11.60	.1861	.2661	.2286	.0323
72	12.81	11.97	.2674	-3.51	11.62	.1767	.2604	[illegible]	.0399

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
12.85	-3.90

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	12.79	6.55	.2294	-3.95	7.93
24	12.79	9.14	.2146	-3.99	10.27
36	12.77	10.33	.2211	-3.98	11.10
48	12.78	10.97	.2132	-3.98	11.29
60	12.85	11.39	.2101	-3.96	11.25
72	12.88	11.77	.2290	-3.93	11.36

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 7

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
14.98	13.77	.2868	-4.20	13.10	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	14.97	13.65	.8330	-4.13	13.01	.7160	.2740	.3138	.1302
24	15.10	13.49	.6451	-4.06	12.94	.4448	.2651	.2885	.0369
36	15.16	13.44	.5106	-4.05	12.95	.2698	.2555	.2499	-.0171
48	15.13	13.39	.4208	-3.96	12.67	.1869	.2633	.2551	-.0238
60	15.01	13.45	.3490	-3.87	12.82	.1696	.2650	.2842	-.0072
72	14.86	13.47	.2685	-3.79	12.86	.1557	.2605	.2598	.0273

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
14.98	-4.20

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
14.81	7.49	.2467	-4.25	9.01
14.75	10.35	.2332	-4.29	11.57
14.75	11.66	.2398	-4.28	12.38
14.80	12.35	.2289	-4.78	12.56
14.87	12.83	.2226	-4.26	12.50
14.90	13.75	.2389	-4.23	12.60

ALTITUDE (KM) - 8

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
16.96	15.26	.2852	-4.55	14.23	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	17.05	15.14	.9314	-4.48	14.15	.7083	.2711	.2932	.1421
24	17.20	15.00	.6445	-4.41	14.09	.4337	.2606	.2660	.0421
36	17.25	14.93	.5176	-4.40	14.09	.2558	.2514	.2301	-.0211
48	17.24	14.90	.4230	-4.29	14.01	.1697	.2576	.2329	-.0315
60	17.13	14.98	.3540	-4.21	13.95	.1526	.2596	.2160	-.0156
72	16.98	14.99	.2761	-4.13	14.00	.1368	.2545	.2455	.0193

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
16.96	-4.55

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
16.89	9.38	.2558	-4.61	9.93
16.82	11.50	.2438	-4.64	12.62
16.82	12.91	.2476	-4.63	13.54
16.87	13.65	.2352	-4.63	13.74
16.93	14.17	.2251	-4.62	13.66
16.98	14.64	.2389	-4.59	13.75

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION 193219) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 9

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
19.08	16.48	.2781	-4.88	15.08	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
19.08	-4.88

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	19.16	16.39	.8351	-4.82	15.02	.7129	.2643	.2697	.1566	19.02	9.00	.2549	-4.93	10.52
24	19.32	16.27	.6520	-4.76	14.96	.4304	.2536	.2412	.0524	18.93	12.35	.2475	-4.96	13.46
36	19.38	16.19	.5174	-4.74	14.96	.2494	.2448	.2108	-.0165	18.93	13.87	.2472	-4.96	14.42
48	19.39	16.18	.4325	-4.64	14.89	.1574	.2498	.2113	-.0324	18.97	14.67	.2341	-4.96	14.65
60	19.30	16.27	.3665	-4.55	14.82	.1369	.2515	.2447	-.0197	19.04	15.22	.2213	-4.96	14.59
72	19.16	16.28	.2900	-4.47	14.87	.1171	.2470	.2285	.0191	19.09	15.75	.2323	-4.93	14.55

ALTITUDE (KM) - 10

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
21.08	17.21	.2623	-5.11	15.47	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
21.08	-5.11

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	21.14	17.15	.8453	-5.05	15.42	.7248	.2569	.2493	.1734	21.03	9.16	.2457	-5.15	10.61
24	21.29	17.04	.6621	-5.00	15.37	.4336	.2473	.2193	.0693	20.94	12.68	.2454	-5.17	13.83
36	21.37	16.94	.5379	-4.98	15.37	.2485	.2390	.1938	-.0031	20.93	14.32	.2423	-5.17	14.83
48	21.40	16.97	.4509	-4.88	15.30	.1886	.2432	.1923	-.0241	20.96	15.18	.2290	-5.18	15.10
60	21.33	17.07	.3660	-4.79	15.22	.1729	.2447	.2224	-.0168	21.02	15.76	.2152	-5.18	15.04
72	21.27	17.07	.3589	-4.71	15.26	.0994	.2410	.2113	.0143	21.07	16.34	.2235	-5.15	15.19

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 11

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
22.62	17.21	.2640	-5.13	15.25	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
22.62	-5.13

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	22.66	17.16	.9605	-5.09	15.20	.7426	.2537	.2375	.1921	22.58	8.76	.2317	-5.16	10.18
24	22.79	17.07	.6943	-5.06	15.17	.4409	.2458	.2062	.0916	22.50	12.31	.2410	-5.18	13.69
36	22.89	17.00	.5651	-5.04	15.16	.2493	.2381	.1824	.0198	22.47	14.05	.2376	-5.19	14.64
48	22.94	17.01	.4777	-4.94	15.10	.1415	.2419	.1791	-.0054	22.48	14.97	.2245	-5.20	14.92
60	22.91	17.11	.4112	-4.83	15.02	.1106	.2431	.2034	-.0044	22.53	15.58	.2116	-5.20	14.90
72	22.79	17.11	.3309	-4.75	15.04	.0855	.2299	.1969	.0220	22.59	16.21	.2181	-5.18	14.94

ALTITUDE (KM) - 12

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
23.36	16.40	.2677	-4.95	14.39	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
23.36	-4.95

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	23.39	16.35	.8770	-4.92	14.34	.7620	.2595	.2395	.2133	23.33	7.98	.2201	-4.97	9.29
24	23.50	16.27	.7228	-4.90	14.33	.4516	.2537	.2061	.1194	23.26	11.28	.2391	-4.98	12.76
36	23.61	16.22	.5962	-4.89	14.32	.2513	.2469	.1795	.0485	23.21	13.06	.2385	-4.99	13.81
48	23.67	16.21	.5084	-4.78	14.27	.1366	.2505	.1737	.0220	23.21	14.01	.2267	-5.00	14.10
60	23.67	16.30	.4378	-4.66	14.19	.1006	.2509	.1915	.0171	23.25	14.66	.2158	-5.01	14.10
72	23.58	16.31	.3526	-4.58	14.18	.0773	.2481	.1883	.0372	23.30	15.32	.2213	-4.99	14.12

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 13

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
23.17	14.90	.7824	-4.59	12.99	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
23.17	-4.59

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	23.10	14.85	.8914	-4.58	12.96	.7805	.2761	.2576	.2362	23.04	6.75	.2136	-4.60	8.10
24	23.18	14.78	.7498	-4.56	12.97	.4660	.2721	.2211	.1596	22.98	9.82	.2416	-4.61	11.42
36	23.30	14.75	.6267	-4.56	12.95	.2556	.2668	.1885	.0837	22.92	11.54	.2462	-4.62	12.46
48	23.37	14.73	.5383	-4.46	12.91	.1352	.2702	.1794	.0549	22.91	12.48	.2368	-4.64	12.73
60	23.39	14.79	.4614	-4.33	12.85	.0945	.2695	.1916	.0453	22.94	13.16	.2282	-4.65	12.74
72	23.32	14.81	.3717	-4.25	12.82	.0759	.2669	.1989	.0580	22.99	13.81	.2343	-4.63	12.75

ALTITUDE (KM) - 14

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
21.70	12.99	.7051	-4.13	11.31	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
21.70	-4.13

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	21.74	12.94	.9035	-4.14	11.29	.7971	.3012	.2901	.2587	21.66	5.64	.2093	-4.13	6.89
24	21.81	12.88	.7712	-4.13	11.30	.4855	.2986	.2509	.1810	21.62	9.24	.2451	-4.14	9.89
36	21.91	12.87	.6512	-4.13	11.29	.2663	.2950	.2120	.1122	21.56	9.81	.2558	-4.16	10.74
48	21.94	12.84	.5612	-4.04	11.26	.1414	.2986	.1994	.0893	21.54	10.70	.2504	-4.18	11.04
60	22.02	12.83	.4770	-3.92	11.21	.0966	.2966	.2065	.0767	21.56	11.38	.2453	-4.20	11.06
72	21.98	12.90	.3850	-3.84	11.16	.0826	.2938	.2013	.0811	21.60	11.98	.2541	-4.19	11.07

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 15

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
19.43	11.00	.3342	-3.69	9.57	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	19.48	10.95	.9034	-3.70	7.56	.8118	.3304	.3318	.2793
24	19.54	10.91	.7852	-3.70	9.57	.5129	.3290	.2937	.2069
36	19.63	10.91	.6674	-3.70	9.56	.2907	.3267	.2515	.1579
48	19.69	10.89	.5758	-3.62	9.54	.1623	.3304	.2359	.1230
60	19.73	10.91	.4841	-3.52	9.50	.1124	.3275	.2373	.1072
72	19.72	10.92	.3928	-3.46	9.48	.0984	.3242	.2277	.1039

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
19.43	-3.69

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
19.39	4.71	.2031	-3.68	5.55
19.34	6.78	.2439	-3.70	8.11
19.29	8.15	.2599	-3.72	9.01
17.28	8.96	.2598	-3.74	9.26
19.29	9.60	.2611	-3.76	9.29
19.32	10.11	.2745	-3.75	9.31

ALTITUDE (KM) - 16

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
16.54	9.21	.3613	-3.33	7.94	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	16.59	9.17	.9023	-3.34	7.94	.8259	.3548	.3759	.2949
24	16.65	9.16	.7948	-3.34	7.95	.5515	.3582	.3452	.2271
36	16.73	9.16	.6812	-3.34	7.94	.3353	.3566	.3053	.1804
48	16.78	9.14	.5886	-3.28	7.92	.2038	.3599	.2977	.1539
60	16.82	9.14	.4970	-3.21	7.90	.1459	.3562	.2812	.1352
72	16.82	9.17	.4033	-3.15	7.88	.1243	.3528	.2657	.1249

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
16.54	-3.33

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
16.49	3.96	.1882	-3.33	4.43
16.45	5.56	.2330	-3.34	6.50
16.41	6.72	.2526	-3.36	7.31
16.40	7.42	.2590	-3.39	7.56
16.41	8.01	.2701	-3.40	7.61
16.43	8.43	.2890	-3.40	7.65

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 17

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
13.37	7.91	.3849	-3.09	6.51	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	13.42	7.79	.9023	-3.09	6.51	.9409	.3839	.4148	.3114
24	13.49	7.79	.8066	-3.10	6.52	.6013	.3837	.3955	.2452
36	13.54	7.80	.7010	-3.09	6.51	.4011	.3816	.3634	.2034
48	13.59	7.80	.6121	-3.04	6.50	.2685	.3840	.3447	.1807
60	13.62	7.81	.5148	-2.99	6.49	.1994	.3799	.3291	.1618
72	13.64	7.82	.4303	-2.95	6.48	.1640	.3768	.3097	.1519

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
13.37	-3.09

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
13.32	3.36	.1692	-3.09	3.46
13.27	4.59	.2181	-3.10	5.07
13.24	5.55	.2379	-3.12	5.78
13.23	6.16	.2498	-3.15	6.04
13.24	6.69	.2710	-3.16	6.13
13.25	7.05	.2943	-3.16	6.18

ALTITUDE (KM) - 18

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
10.17	6.87	.3995	-2.96	5.32	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	10.22	6.87	.9065	-2.96	5.33	.8556	.4003	.4797	.3250
24	10.29	6.88	.8235	-2.97	5.34	.6559	.3994	.4311	.2610
36	10.34	6.90	.7331	-2.96	5.24	.4789	.3962	.4079	.2232
48	10.37	6.91	.6511	-2.92	5.33	.3506	.3973	.3893	.2044
60	10.40	6.92	.5581	-2.69	5.22	.2698	.3933	.3760	.1887
72	10.43	6.93	.4810	-2.66	5.21	.2179	.3906	.3434	.1780

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
10.17	-2.96

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
10.12	2.89	.1480	-2.96	2.70
10.06	3.86	.2029	-2.97	3.90
10.04	4.64	.2200	-2.99	4.50
10.04	5.20	.2340	-3.01	4.77
10.04	5.59	.2619	-3.02	4.90
10.05	6.02	.2871	-3.03	4.98

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 19

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
7.15	6.37	.3985	-2.91	4.41	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
7.15	-2.91

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	7.20	6.39	.9123	-2.91	4.43	.8627	.4003	.4421	.3390	7.10	2.60	.1187	-2.92	2.18
24	7.27	6.43	.8425	-2.92	4.43	.7005	.3981	.4410	.2715	7.04	3.40	.1810	-2.92	3.05
36	7.31	6.46	.7677	-2.91	4.43	.5503	.3940	.4225	.2385	7.02	4.06	.2016	-2.94	3.55
48	7.35	6.47	.6945	-2.88	4.43	.4329	.3939	.4037	.2219	7.01	4.57	.2174	-2.96	3.87
60	7.37	6.49	.6102	-2.86	4.43	.3438	.3911	.3725	.2094	7.01	5.04	.2492	-2.97	3.98
72	7.41	6.51	.5422	-2.84	4.42	.2760	.3897	.3477	.1965	7.01	5.35	.2734	-2.97	4.08

ALTITUDE (KM) - 20

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
4.48	6.30	.3791	-2.92	3.81	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
4.48	-2.92

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	4.54	6.37	.9187	-2.91	3.83	.8623	.3797	.4190	.3222	4.42	2.44	.0770	-2.93	1.99
24	4.61	6.38	.8599	-2.92	3.82	.7297	.3762	.4238	.2760	4.37	3.20	.1341	-2.93	2.53
36	4.66	6.42	.7932	-2.91	3.83	.6731	.3719	.4150	.2455	4.34	3.82	.1767	-2.94	2.95
48	4.69	6.45	.7270	-2.89	3.83	.4986	.3711	.3860	.2269	4.33	4.32	.2003	-2.96	3.20
60	4.72	6.47	.6510	-2.87	3.83	.4038	.3706	.3452	.2141	4.33	4.78	.2407	-2.96	3.39
72	4.76	6.50	.5880	-2.86	3.83	.3250	.3708	.3183	.1954	4.32	5.09	.2637	-2.97	3.51

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT)
YP = V(AT T + DT)

ALTITUDE (KM) - 21

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
2.29	6.57	.3558	-2.92	3.48	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
2.29	-2.92

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	2.35	6.63	.9260	-2.91	3.49	.6616	.3566	.3875	.3163	2.23	2.48	.0451	-2.93	1.74
24	2.42	6.67	.8734	-2.92	3.49	.7947	.3526	.3924	.2865	2.17	3.20	.0880	-2.93	2.27
36	2.48	6.72	.8087	-2.92	3.50	.6350	.3491	.3725	.2561	2.14	3.86	.1568	-2.94	2.63
48	2.51	6.75	.7447	-2.90	3.51	.5376	.3486	.3496	.2336	2.13	4.38	.1959	-2.95	2.87
60	2.55	6.76	.6729	-2.88	3.51	.4382	.3498	.2996	.2151	2.12	4.86	.2474	-2.96	3.09
72	2.60	6.80	.6097	-2.88	3.51	.3537	.3515	.2668	.1928	2.10	5.21	.2729	-2.96	3.21

ALTITUDE (KM) - 22

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
.62	7.12	.3523	-2.91	3.36	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
.62	-2.91

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.69	7.19	.9325	-2.90	3.37	.8629	.3523	.3716	.3251	.56	2.57	.0481	-2.92	1.68
24	.76	7.23	.8818	-2.90	3.38	.7499	.3497	.3707	.3059	.49	3.36	.0886	-2.92	2.19
36	.83	7.28	.8191	-2.70	3.39	.6470	.3474	.3492	.2769	.45	4.09	.1644	-2.93	2.53
48	.87	7.31	.7516	-2.88	3.40	.5496	.3481	.3188	.2511	.44	4.70	.2170	-2.94	2.77
60	.91	7.31	.6784	-2.87	3.40	.4465	.3500	.2621	.2287	.43	5.23	.2730	-2.94	2.99
72	.98	7.34	.6145	-2.87	3.41	.3586	.3525	.2199	.2082	.41	5.62	.3003	-2.94	3.12

BIVARIATE NORMAL STATISTICS OF X, Y

STATION 1932141 - VANDENBERG

X = U(AT T)
Y = V(AT T)

MONTH	PER. OF REC.	ALT KM.	ALPHA DEG.	MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
1	2/65 - 11/74	5	90.0	10.74	10.65	.2638	-3.63	10.64	620
1	2/65 - 11/74	6	90.0	12.85	12.22	.2778	-3.90	11.87	620
1	2/65 - 11/74	7	90.0	14.88	13.77	.2868	-4.70	13.10	620
1	2/65 - 11/74	8	90.0	16.96	15.26	.2852	-4.55	14.23	620
1	2/65 - 11/74	9	90.0	19.08	16.48	.2781	-4.88	15.08	620
1	2/65 - 11/74	10	90.0	21.08	17.21	.2693	-5.11	15.47	620
1	2/65 - 11/74	11	90.0	22.62	17.21	.2640	-5.13	15.25	620
1	2/65 - 11/74	12	90.0	23.36	16.40	.2677	-4.95	14.38	620
1	2/65 - 11/74	13	90.0	23.07	14.20	.2824	-4.59	12.99	620
1	2/65 - 11/74	14	90.0	21.70	12.99	.3061	-4.13	11.31	620
1	2/65 - 11/74	15	90.0	19.43	11.00	.3342	-3.69	9.57	620
1	2/65 - 11/74	16	90.0	16.54	9.21	.3613	-3.33	7.94	620
1	2/65 - 11/74	17	90.0	13.37	7.91	.3849	-3.09	6.51	620
1	2/65 - 11/74	18	90.0	10.17	6.87	.3995	-2.96	5.32	620
1	2/65 - 11/74	19	90.0	7.15	6.37	.3985	-2.91	4.91	620
1	2/65 - 11/74	20	90.0	4.48	6.30	.3781	-2.92	3.81	620
1	2/65 - 11/74	21	90.0	2.29	6.57	.3558	-2.92	3.48	620
1	2/65 - 11/74	22	90.0	.62	7.12	.3523	-2.91	3.36	620

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/79
ALPHA ANGLE - 96.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 5

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
13.74	10.65	.2638	-3.63	10.64	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
13.74	-3.63

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.08	6.04	-.3022	.04	7.50	-.3627	.2272	.1130	-.2368	6.75	9.98	.2685	2.37	9.68
24	.15	8.83	-.4455	.11	10.76	-.5168	.2680	.0552	-.2382	6.02	9.40	.2835	.59	8.92
36	.23	10.33	-.5131	.10	12.49	-.5924	.1939	.0120	-.2241	5.87	9.04	.2858	-.23	8.46
48	.19	11.27	-.5583	.17	13.13	-.6298	.1733	.0169	-.2173	5.77	8.74	.3395	-.32	8.15
60	.07	11.95	-.5859	.26	13.32	-.6432	.1402	.0331	-.2025	5.72	8.53	.3364	-.38	8.04
72	-.06	12.72	-.6176	.35	13.52	-.6512	.1260	.0080	-.1773	5.59	8.31	.3447	-.73	8.01

ALTITUDE (KM) - 6

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
12.85	12.22	.2798	-3.90	11.87	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
12.85	-3.90

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.09	6.96	-.3026	.05	8.66	-.3750	.2544	.0761	-.2246	7.85	11.5[illegible]	.2810	2.38	10.85
24	.19	10.13	-.4432	.12	12.22	-.5291	.2388	.0217	-.2411	7.18	10.82	.2878	.64	9.91
36	.26	11.89	-.5131	.12	14.05	-.6019	.2349	-.0193	-.2472	7.06	10.38	.2872	-.12	9.36
48	.22	12.94	-.5579	.21	14.79	-.6364	.2197	-.0126	-.2356	6.93	10.04	.3100	-.23	9.01
60	.10	13.75	-.5862	.30	14.97	-.6486	.1591	.0096	-.2209	6.87	9.79	.3330	-.32	8.92
72	-.04	14.62	-.6186	.39	15.13	-.6536	.1508	-.0128	-.1927	6.71	9.[illegible]3	.3556	-.74	8.92

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 7

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
14.88	13.77	.2868	-4.20	13.10	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
14.88	-4.20

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.09	7.92	-.3338	.16	9.84	-.3846	.2689	.0418	-.2096	8.85	13.00	.2857	2.05	11.93
24	.22	11.49	-.4419	.14	13.72	-.5356	.2568	-.0052	-.2391	8.30	12.23	.2875	.54	10.92
36	.28	13.46	-.5136	.19	15.74	-.6102	.2507	-.0440	-.2527	8.19	11.70	.2925	-.12	10.26
48	.25	14.62	-.5567	.24	16.56	-.6459	.2337	-.0365	-.2454	8.05	11.33	.3043	-.24	9.88
60	.13	15.53	-.5846	.33	16.71	-.6541	.1880	-.0783	-.2304	8.01	11.05	.3344	-.31	9.79
72	-.02	16.49	-.6163	.41	16.97	-.6581	.1661	-.0273	-.2019	7.80	10.76	.3474	-.79	9.80

ALTITUDE (KM) - 8

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
16.96	15.26	.2852	-4.55	14.23	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
16.96	-4.55

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.09	8.43	-.3023	.07	10.94	-.3882	.2734	.0109	-.1889	9.81	14.45	.2812	1.43	13.09
24	.24	12.76	-.4382	.14	15.06	-.5393	.2661	-.0283	-.2307	9.42	13.60	.2798	.30	11.86
36	.30	14.94	-.5112	.15	17.27	-.6151	.2731	-.0613	-.2521	9.32	12.99	.2724	-.21	11.11
48	.29	16.20	-.5527	.25	18.19	-.6513	.2477	-.0543	-.2473	9.21	12.60	.2917	-.33	10.68
60	.17	17.19	-.5793	.34	18.35	-.6595	.1992	-.0214	-.2330	9.18	12.30	.3213	-.37	10.58
72	.03	18.20	-.6110	.42	18.55	-.6640	.1743	-.0369	-.2082	9.94	11.98	.3363	-.89	10.58

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (932141)	- VANDENBERG	X	= U(AT T)
MONTH OF RECORD	- JANUARY	Y	= V(AT T)
PERIOD OF RECORD	- 2/65 - 11/79	XP	= U(AT T + DT) - U(AT T)
ALPHA ANGLE	- 90.0	YP	= V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 9

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
19.08	16.98	.2781	-4.88	15.09	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.08	9.44	-.2961	.07	11.42	-.3844	.2666	-.0173	-.1614
24	.23	13.66	-.4390	.13	15.03	-.5392	.2682	-.0483	-.2128
36	.30	16.02	-.5042	.15	18.41	-.6167	.2798	-.0732	-.2413
48	.31	17.40	-.5452	.24	19.46	-.6549	.2531	-.0670	-.2404
60	.21	18.48	-.5707	.33	19.65	-.6645	.2059	-.0328	-.2294
72	.07	19.52	-.6027	.41	19.90	-.6704	.1796	-.0443	-.2002

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
19.08	-4.88

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
10.68	15.68	.2737	.57	13.86
10.49	14.79	.2694	-.06	12.61
10.43	14.13	.2614	-.38	11.78
10.36	13.71	.2759	-.46	11.30
10.36	13.41	.3047	-.46	11.16
10.19	13.06	.3215	-1.00	11.13

ALTITUDE (KM) - 10

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
21.08	17.21	.2693	-5.11	15.47	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.06	9.56	-.2846	.06	11.46	-.3759	.2510	-.0378	-.1393
24	.21	13.93	-.4168	.17	16.41	-.5765	.2641	-.0644	-.1892
36	.29	16.43	-.4923	.12	18.90	-.6164	.2704	-.0820	-.2279
48	.32	17.91	-.5338	.22	20.09	-.6573	.2522	-.0766	-.2259
60	.25	19.39	-.5593	.32	20.33	-.6491	.2197	-.0441	-.2175
72	.12	20.15	-.5924	.49	20.62	-.6766	.1802	-.0510	-.1914

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
21.08	-5.11

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
11.39	16.47	.2661	-.34	14.31
11.37	15.58	.2607	-.44	13.00
11.39	14.90	.2530	-.57	12.11
11.36	14.46	.2645	-.60	11.57
11.42	14.16	.2894	-.55	11.40
11.16	13.79	.3078	-1.08	11.34

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (972140) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 11

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
22.62	17.21	.2640	-5.13	15.25	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.04	9.08	-.2694	.08	10.92	-.3624	.2324	-.0516	-.1011
24	.17	13.40	-.3997	.07	16.08	-.5321	.2568	-.0763	-.1639
36	.27	15.96	-.4765	.09	18.63	-.6155	.2640	-.0904	-.2008
48	.32	17.49	-.5196	.19	19.88	-.6593	.2485	-.0857	-.2066
60	.29	18.62	-.5466	.30	20.18	-.6732	.2123	-.0572	-.2027
72	.17	19.05	-.5017	.39	20.88	-.6818	.1819	-.0591	-.1894

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
22.62	-5.13

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
11.87	16.56	.2631	-1.15	14.20
11.95	15.74	.2589	-.78	12.88
12.04	15.07	.2521	-.76	11.96
12.05	14.64	.2623	-.74	11.40
12.16	14.33	.2826	-.65	11.20
11.93	13.94	[illegible]	-1.13	11.11

ALTITUDE (KM) - 12

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
23.36	16.46	.2677	-4.95	14.39	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.08	8.12	-.2534	.03	9.91	-.3988	.2173	-.0582	-.0797
24	.14	12.16	-.3013	.05	15.14	-.5761	.2513	-.0851	-.1422
36	.25	14.6[illegible]	-.4589	.05	17.56	-.6141	.2612	-.1008	-.1797
48	.31	16.17	-.5043	.16	18.83	-.6664	.2478	-.0973	-.1879
60	.31	17.33	-.5342	.28	19.16	-.6762	.2176	-.0731	-.1883
72	.22	18.61	-.5721	.37	19.40	-.6848	.1975	-.0709	-.1712

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
23.36	-4.95

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
11.96	15.86	.2695	-1.64	13.48
12.08	15.14	.2682	-.99	12.21
12.23	14.53	.2634	-.91	11.32
12.26	14.12	.2733	-.85	10.76
12.41	13.81	.2895	-.74	10.59
12.24	13.41	.3075	-1.13	10.95

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - [illegible]65 - 11/78
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM)

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
23.07	14.90	.2824	-4.59	12.99	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
23.07	-4.55

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.06	6.93	-.2395	.01	8.60	-.3345	.2695	-.0551	-.0706	11.61	14.46	.2868	-1.56	12.24
24	.11	10.49	-.3636	.07	13.41	-.5182	.2505	-.0896	-.1280	11.74	13.86	.2897	-1.10	11.10
36	.23	12.81	-.4415	.09	15.83	-.6117	.2632	-.1114	-.1633	11.91	13.35	.2880	-.98	10.26
48	.33	14.24	-.4894	.13	17.04	-.6602	.2522	-.1099	-.1737	11.95	12.97	.2986	-.90	9.73
60	.32	15.41	-.5238	.25	17.39	-.6775	.2254	-.0891	-.1776	12.12	12.66	.3125	-.79	9.52
72	.25	16.65	-.5641	.34	17.55	-.6849	.1982	-.0896	-.1667	12.02	12.27	.3282	-1.10	9.44

ALTITUDE (KM) - 14

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
21.70	12.99	.3061	-4.13	11.31	620

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
21.70	-4.13

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.14	5.78	[illegible]	-.00	[illegible]	-.3210	.2063	-.0368	[illegible]	10.98	[illegible]	.3131	-.79	11.76
24	.11	8.75	-.3488	[illegible]	11.47	[illegible]	.2522	-.0849	-.1234	11.01	12.15	.3233	-.73	9.73
36	.21	10.66	-.4267	[illegible]	[illegible]	-.6167	.2615	-.1155	-.1541	11.14	11.73	.3234	-.90	8.97
48	.28	12.10	-.4776	.10	14.79	[illegible]	.2578	-.1169	-.1661	11.17	11.40	.3356	-.84	8.50
60	.32	13.23	-.5159	.21	15.13	-.6756	[illegible]	[illegible]	-.1719	11.32	[illegible]	.3489	-.78	8.31
72	.28	14.35	-.5587	.29	15.23	-.6818	.2113	-.0960	-.1678	[illegible]	10.75	[illegible]	-1.01	8.25

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/78
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 15

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
19.43	11.03	.3342	-3.69	9.57	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.05	4.82	-.2285	-.11	5.87	-.3082	.2028	-.0287	-.0916
24	.11	7.18	-.3378	-.01	9.44	-.4928	.2518	-.0654	-.1287
36	.20	8.93	-.4156	-.01	11.39	-.5960	.2645	-.1042	-.1525
48	.25	10.08	-.4692	.07	12.36	-.6485	.2568	-.1098	-.1637
60	.33	11.13	-.5133	.17	12.70	-.6668	.2345	-.0975	-.1715
72	.29	12.08	-.5554	.23	12.79	-.6752	.2212	-.0988	-.1771

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
19.43	-3.69

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
10.08	10.69	.3441	.38	9.08
9.98	10.34	.3553	-.18	8.30
10.04	9.99	.3641	-.62	7.66
10.03	9.70	.3794	-.65	7.26
10.15	9.42	.3927	-.67	7.09
10.14	9.13	.4009	-.87	7.64

ALTITUDE (KM) - 16

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
16.54	9.21	.3603	-3.73	7.94	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.05	4.46	-.2293	-.01	4.62	-.2955	.1900	.0297	-.1128
24	.11	5.89	-.3284	-.01	7.03	-.4723	.2434	-.0784	-.1413
36	.18	7.34	-.4058	-.01	9.15	-.5767	.2522	-.0724	-.1573
48	.24	6.33	-.4598	.05	10.01	-.6321	.2446	-.0837	-.1648
60	.28	9.26	-.5077	.17	10.35	-.6556	.2286	-.0811	-.1729
72	.28	10.[illegible]	-.5491	.18	10.47	-.6649	.2223	-.0889	-.1785

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
16.54	-3.33

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
8.95	9.94	.3752	1.30	7.55
8.77	8.68	.3893	.44	6.96
8.77	8.43	.4034	-.73	6.46
8.07	8.16	.4223	-.41	6.13
8.74	7.94	.4353	-.54	5.97
[illegible]	7.68	.4418	-.73	5.91

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (932141) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/74
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 17

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
13.37	[illegible].81	.3849	-3.09	6.51	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.05	3.45	-.2267	-.09	3.67	-.2914	.1717	.0652	-.1300
24	.12	4.85	-.3150	-.01	5.82	-.4446	.2308	.0154	-.1557
36	.18	6.04	-.3886	-.09	7.13	-.5469	.2362	-.0286	-.1657
48	.22	6.[illegible]	-.4923	.05	7.97	-.6054	.2286	-.0465	-.1691
60	.25	7.70	-.4928	.09	8.23	-.6341	.2196	-.0567	-.1773
72	.27	8.34	-.5334	.14	8.40	-.6490	.2170	-.0703	-.1813

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
13.37	-3.09

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
7.67	7.58	.4032	1.50	6.20
7.44	7.39	.4177	.76	5.78
7.31	7.17	.4345	.04	5.41
7.23	6.99	.4552	-.25	5.15
7.23	6.78	.4680	-.48	5.00
7.21	6.59	.4758	-.67	4.93

ALTITUDE (KM) - 18

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
13.17	6.87	.3995	-2.96	5.32	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.05	2.97	-.2165	.00	2.86	-.2657	.1512	.0930	-.1374
24	.12	4.08	-.2930	-.01	4.42	-.4116	.2168	.0547	-.1657
36	.17	5.03	-.3596	-.07	5.44	-.5084	.2214	.0142	-.1718
48	.20	5.75	-.4115	.04	6.17	-.5650	.2128	-.0093	-.1778
60	.23	6.49	-.4634	.07	6.43	-.6042	.2189	-.0323	-.1744
72	.26	7.13	-.5024	.10	6.65	-.6267	.2102	-.0515	-.1775

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
13.17	-2.96

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
6.24	6.57	.4205	1.19	5.08
6.09	6.53	.4732	.60	4.79
5.91	6.37	.4490	.00	4.53
5.79	6.23	.4686	-.32	4.34
5.73	6.06	.4813	-.59	4.21
5.71	5.92	.4900	-.75	4.13

QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (72393) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 2/65 - 11/78
ALPHA ANGLE - 90.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - 1[illegible]

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
7.15	6.37	.3985	-2.91	8.41	620

DT MO	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.06	2.67	-.2015	.0[illegible]	2.72	-.2566	.1217	.1079	-.1286
24	.13	3.57	-.2668	-.01	3.47	-.3829	.1928	.0820	-.1525
36	.17	4.37	-.3290	-.20	4.2[illegible]	-.4703	.2023	.0829	-.1672
48	.23	5.02	-.3735	.03	4.71	-.5298	.1991	.0188	-.1487
60	.23	5.68	-.4283	.05	5.[illegible]	-.5709	.2641	-.0215	-.1482
72	.26	6.17	-.4608	.07	5.1[illegible]	-.6005	.2106	-.0807	-.1678

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
7.15	-2.91

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
4.87	6.21	.4284	.26	4.22
4.77	4.10	.4299	.08	4.02
4.58	5.99	.4415	-.37	3.88
4.37	5.88	.4569	-.52	3.70
4.28	5.75	.4673	-.85	3.69
4.24	5.64	.4755	-.96	3.51

ALTITUDE (KM) - [illegible]

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
4.58	6.30	.3781	-2.9[illegible]	5.81	620

DT MO	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.[illegible]6	2.55	-.1858	.01	[illegible]	-.2[illegible]	.2778	.1081	-.1081
24	.13	3.36	-.28[illegible]	[illegible]	2.9[illegible]	-.38[illegible]	.1381	.0958	-.1376
36	.18	4.07	-.2980	[illegible]	3.4[illegible]	-.4817	.1717	.0537	-.1873
48	.21	4.71	-.3815	.03	3.53	-.4963	.1871	.0729	-.1892
60	.24	5.30	-.3[illegible]	.15	4.17	-.54[illegible]	.2[illegible]40	-.0[illegible]	-.18[illegible]
72	.23	5.41	-.42[illegible]	[illegible]	4.88	-.5781	.2213	-.0[illegible]	-.15[illegible]

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
4.48	-2.92

MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
3.37	6.1[illegible]	.3993	-.58	3.65
3.38	6.04	.4[illegible]72	-.65	3.57
3.19	5.99	.4134	-.87	3.38
3.[illegible]	5.87	.4230	-.97	3.28
2.71	5.74	.4271	-1.13	3.17
2.88	5.63	.4388	-1.19	3.19

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QUADRAVARIATE AND CONDITIONAL BIVARIATE NORMAL STATISTICS OF X, Y, XP, YP

STATION (93214) - VANDENBERG
MONTH OF RECORD - JANUARY
PERIOD OF RECORD - 1/65 - 11/74
ALPHA ANGLE - 20.0

X = U(AT T)
Y = V(AT T)
XP = U(AT T + DT) - U(AT T)
YP = V(AT T + DT) - V(AT T)

ALTITUDE (KM) - .1

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
2.29	6.57	.3556	-2.92	3.48	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.07	2.54	-.1777	.01	1.33	-.2576	.0415	.0906	-.0731
24	.14	3.33	-.2224	.00	2.49	-.3539	.1001	.0843	-.0958
36	.17	4.11	-.2759	.02	2.98	-.4224	.1422	.0404	-.1149
48	.22	4.76	-.3244	.03	3.36	-.4748	.1746	.0045	-.1248
60	.26	5.40	-.3742	.04	3.71	-.5245	.2216	-.0578	-.1305
72	.32	5.91	-.4179	.05	3.98	-.5635	.2456	-.0889	-.1415

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
2.29	-2.92

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	2.01	6.46	.3747	-1.16	3.35
24	1.97	6.37	.3838	-1.18	3.23
36	1.90	6.30	.3869	-1.25	3.14
48	1.80	6.23	.3920	-1.29	3.05
60	1.65	6.08	.3923	-1.35	2.96
72	1.62	5.94	.3941	-1.36	2.87

ALTITUDE (KM) - .2

QUADRAVARIATE NORMAL STATISTICS OF X,Y,XP,YP

MEAN X	S.D. X	R (X,Y)	MEAN Y	S.D. Y	N
.62	7.12	.3523	-2.91	3.36	620

DT HR	MEAN XP	S.D. XP	R (X,XP)	MEAN YP	S.D. YP	R (Y,YP)	R (XP,YP)	R (XP,Y)	R (YP,X)
12	.07	2.63	-.1613	.01	1.76	-.2776	.0417	.0609	[illegible]
24	.14	3.49	-.2145	.01	2.36	-.3467	.0779	.0487	-.0576
36	.21	4.34	-.2674	.01	2.84	-.4137	.1443	.0077	-.0971
48	.25	5.09	-.3255	[illegible]	3.21	-.4661	.1942	-.0355	-.1073
60	.29	5.79	-.3733	.04	3.55	-.5161	.2513	-.1023	-.1194
72	.36	6.35	-.4213	.04	3.83	-.5785	.2791	-.1410	-.1242

CONDITIONAL BIVARIATE NORMAL STATISTICS FOR XP AND YP

GIVEN X	GIVEN Y
.62	-2.91

DT HR	MEAN XP	S.D. XP	R (XP,YP)	MEAN YP	S.D. YP
12	.97	7.02	.3691	-1.41	3.24
24	.84	6.93	.3794	-1.42	3.14
36	.81	6.86	.3827	-1.42	3.05
48	.74	6.74	.3846	-1.43	2.97
60	.67	6.61	.3824	-1.44	2.88
72	.57	6.49	.3822	-1.45	2.79

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