The Reliability of the Daily Quick Look Solar Wind Velocities as Indicators of Interplanetary Activity

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It is shown that the daily quick look solar wind velocities based on the Ames Research Center solar wind plasma data obtained on the Pioneer spacecraft are surprisingly reliable indicators of interplanetary activity. These velocities, which are published in the monthly *Solar Geophysical Data* by NOAA, can appropriately be used in correlation studies with an average accuracy of ±5%. This accuracy reflects the 'jitter' in the solar wind velocity during quiescent intervals and across high-speed streams.

Pioneer solar wind velocities from the Ames Research Center (ARC) solar wind plasma experiment have been published (*Solar Geophysical Data*) since 1968 as a service to the scientific community. These quick look data are based upon daily teletype sampling of the ARC data. The ARC plasma analyzers on Pioneer 6, 7, 8, and 9 are multicollector curved plate electrostatic analyzers [*Wolfe and McKibbin*, 1968; *Intriligator et al.*, 1969]. The accuracy of the Pioneer 6 and 7 velocity measurements are discussed by *Mihalov and Wolfe* [1971]. Since the daily quick look data are based only upon a few minutes of data, potential users of the data have been warned not to interpret the data as a daily average. In this report we compare the quick look data with the daily average of the data.

The solar wind data used for this study are from Pioneer 6 and Pioneer 7 and were obtained in 1965 and 1966. Figure 1 shows the comparisons between the daily quick look proton speeds (the crosses in the figure) and the daily averages (the solid lines) for solar rotation 1812 (December 24, 1965, to January 19, 1966). Qualitatively, it is clear that the general trends in both types of data are quite similar (e.g., high-speed streams). Quantitatively though, there are some differences in the magnitude of the speeds.

A percentage difference between the daily average speed and the quick look speed was computed for each day: it equals the quotient of the daily average speed divided into the difference between the daily average speed and the quick look speed. By using all the available Pioneer 6 and 7 measurements in 1965 and 1966 (~200 daily averages), it was found that the average accuracy of the quick look data was ±5%.

Table 1 lists for solar rotation 1812 (as measured at Pioneer 6) the daily average solar wind proton streaming speed, the quick look value of the streaming speed, and the percentage difference. The data in this table indicate that although the overall Pioneer average percentage difference is ±5% between the daily average solar wind proton speed and the quick look speed values, on any individual day there can be a very large percentage difference (i.e., December 30, 1965, and January 14, 1966). Therefore the quick look data are useful for studying general trends in the solar wind but should not be relied upon too heavily in studies involving any one particular day.

The average accuracy (±5%) is surprisingly good and indicates that the daily quick look solar wind data can be used as representative solar wind speeds for a number of studies (e.g., solar-interplanetary relations, the configuration of the interplanetary medium, and interplanetary-magnetospheric interactions). Since the quick look data are readily available on a day to day basis, this study indicates that in addition to being convenient the data are also more reliable and representative of the state of the solar wind than was previously believed. The ±5% average accuracy of the quick look solar wind speeds in general reflects the 'jitter' in the solar wind speed during quiescent intervals and across high-speed streams.

Note that this study refers to spacecraft measurements made at a specific location in interplanetary space. In other words the quick look velocity data at a particular point in interplanetary space provide a reliable indicator of the 24-h average velocity at the same position. The *Solar Geophysical Data* indicate the corotation delay time between the spacecraft and the earth. An earlier study by *Gosling* [1971, 1972] showed excellent agreement (correlation coefficient of

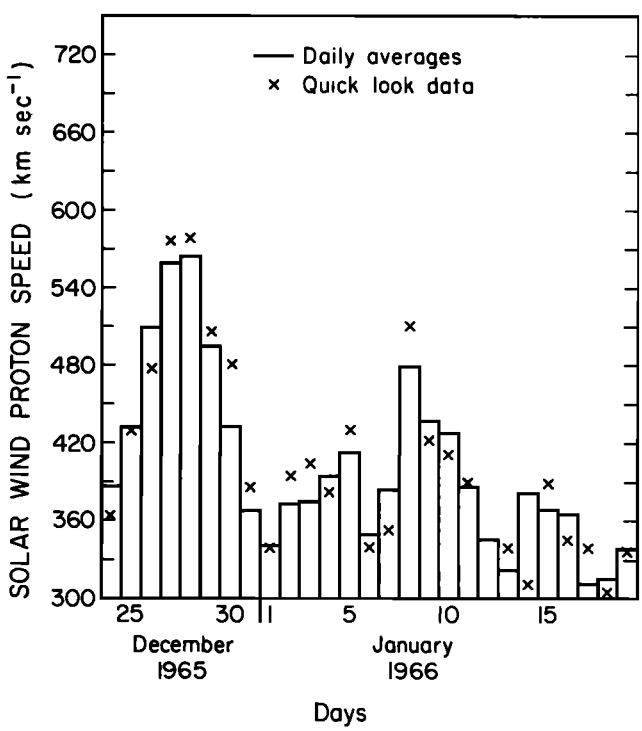

Fig. 1. An example of the comparison between the daily quick look proton speeds (crosses) and the daily averages (solid lines). These data are from solar rotation 1812 (December 24, 1965, to January 19, 1966).

TABLE 1. Solar Wind Proton Streaming Speed as Measured at Pioneer 6 for Solar Rotation 1812

Day	Daily Average, km s^{-1}	Quick Look Value, km s^{-1}	Difference, %
	December 1965		
24	387	363	6.2
25	431	431	0
26	509	476	6.5
27	559	577	−3.2
28	564	578	−2.5
29	495	507	−2.4
30	433	481	−11.1
31	369	386	−4.6
	January 1966		
1	341	339	0.6
2	374	395	−5.6
3	375	403	−7.5
4	395	381	3.5
5	413	432	−4.6
6	347	339	2.3
7	384	353	8.1
8	480	510	−6.2
9	438	422	3.7
10	428	410	4.2
11	387	391	−1.0
12	346		
13	322	339	−5.3
14	382	311	18.6
15	370	388	−4.9
16	366	345	5.7
17	312	339	−8.7
18	316	305	3.5
19	339	338	0.3

0.66) between the velocity data of Pioneer 6 and 7 when the two spacecraft were separated by ≤2 days corotation delay time. The agreement decreased (0.28) when the spacecraft separation was >4 days. Lack of agreement (0.29) also occurred when shifts of 6–13 days were involved in the separation of Pioneer 7 and the earth-orbiting Vela 3, 4, and 5.

The quick look solar wind velocities are therefore indicative of the daily interplanetary configuration at a particular point in space but can also be used with some confidence to study or predict the solar wind configuration at a second point separated by a corotation delay ≤2 days.

It is hoped that other studies of this kind will be performed with a variety of interplanetary parameters so that comparisons between a number of physical phenomena (e.g., solar, interplanetary, and magnetospheric) can be carried out with a more well-defined knowledge of the confidence levels and limitations involved.

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