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# NOAA Technical Report NESDIS 118

**Simultaneous Nadir Overpasses for NOAA-6 to NOAA-17  
Satellites from 1980 to 2003 for the Intersatellite  
Calibration of Radiometers**



Washington, D.C.  
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**U.S. DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
National Environmental Satellite, Data, and Information Service

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## Simultaneous Nadir Overpasses for NOAA-6 to NOAA-17 Satellites from 1980 to 2003 for the Intersatellite Calibration of Radiometers



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**Simultaneous Nadir Overpasses for NOAA-6 to NOAA-17 Satellites  
from 1980 to 2003 for the Intersatellite Calibration of Radiometers**

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## ABSTRACT

Simultaneous nadir overpasses (SNOs) for pairs of NOAA satellites (NOAA-6 to NOAA-17) from 1980 to 2003 are calculated with the version 2.0 of the SNO prediction algorithm, which utilizes the Simplified General Perturbation No. 4 (SGP4). These SNOs occur in the polar regions, where the radiometers from two satellites view the same place at the same time at nadir, providing excellent opportunities for intersatellite calibration. The SNOs are useful for monitoring the on-orbit instrument performance and evaluating the calibration consistency for climate trending studies with NOAA's satellite radiometers in the visible/near-infrared, infrared, and microwave.

Version 2.0 of the SNO prediction algorithm significantly improved the prediction accuracy. All the SNOs found using this version are predicted with a time interval of 1 second (entitled Class I SNOs), compared to the 30 second interval in previous predictions (Class II SNOs). The SNO nadir distances criteria is now  $< 100$  km, compared to  $< 300$  km before. As a result, the predicted locations are closer to the precise SNO locations than those in previous predictions. Algorithm Version 2.0 also fully utilizes all available historical two-line-elements (TLEs) as input to the SGP4 model for optimized TLE epoch matching (epoch is the time at which the orbital data are calculated). These are made possible with the enhanced algorithm and further improvements in computing power. The predictions for the SNOs include the date, time, location, nadir ground distance, TLE epoch differences, and the approximate angle of the orbital intersection with the delta right ascension of ascending node (RAAN). The computer algorithm and source code for predicting the SNOs in C++ programming language are provided. Existing studies using the SNO method are also

introduced and provided in the references. Updates on the SNOs are available at the website:

<http://orbit.nesdis.noaa.gov/smcd/spb/sno/>.



## 1. INTRODUCTION

Intercalibrating the polar-orbiting radiometers on different satellites is critical for achieving the calibration consistency and traceability required for long-term climate studies with the 25+ years of NOAA satellite data. Many inter-calibration studies have been performed in the past. But most of them are limited to match-up data sets acquired from different satellites with dissimilar instruments and that may have different observation times and viewing geometries, and in many cases rely on radiative transfer calculations to account for the observation differences. These restrictions introduce uncertainties in the inter-comparisons.

In recent years, the Simultaneous Nadir Overpasses (SNOs) method has been developed and refined for the intersatellite calibration of radiometers (Cao et al., 2004). At each SNO, radiometers from both satellites view the same place at the same time at nadir, thus eliminating uncertainties associated with differences of atmospheric path, viewing geometry, and observation time. This is especially important for infrared radiometer observations, which vary significantly with these parameters. As a result, uncertainties in the inter-satellite calibration are greatly reduced. Several studies have used this method for calibrating radiometers on meteorological satellites, including the intercalibration of the HIRS (High Resolution Infrared Radiation Sounder) (Cao et al., 2005), AVHRR (Advanced Very High Resolution Radiometer) and MODIS (Moderate Resolution Imaging Spectroradiometer) in the infrared (Cao and Heidinger, 2002, Wu et al., 2003) and visible channels (Heidinger et al., 2002), and Microwave Sounding Unit (Zou et al., 2005). Results show that this method is useful for the on-orbit verification of instrument performance for newly launched

radiometers, as well as retrospective analyses of historical data for constructing time series for climate studies. Therefore, we believe that the predicted SNOs for NOAA-satellites from 1980 to 2003 provided in this study will be useful to the research community for the intersatellite calibration of radiometers.

The SNO method, when used properly and combined with SNO time series analysis, may have profound impact on the intersatellite calibration across the board for satellite radiometers in the visible/near infrared, infrared, and microwave. Preliminary studies have shown that significant improvements have been made in the following areas:

First, radiometric differences between satellites are quantified with greatly reduced uncertainty. Before the SNO method was used, intersatellite calibration biases often could not be separated from the true differences in the geophysical variables due to diurnal temperature (infrared and microwave) or Sun angle and bidirectional reflectance factor (BRDF) differences (solar reflective). This is because satellites have different equator crossing and observation times, which are further intertwined with orbital drift over time. Therefore, previously, intersatellite biases could only be estimated with an uncertainty on the order of a few degrees in most cases. With the SNO method, the intersatellite calibration biases are quantified with much smaller uncertainties across the board for nearly all satellite radiometers.

A major break-through has been made for the upper atmosphere sounding channels of the High Resolution Infrared Radiation Sounder (HIRS), for which little “ground truth” is available. Due to the relative spatial homogeneity of the upper atmosphere, the intersatellite calibration biases become highly quantifiable with the SNO method with a small uncertainty on the order of 0.1 K (less than the instrument noise) at the cold scene temperature (Cao et

al., 2005). For the Microwave instruments, results using the SNO method show excellent agreement (uncertainty  $\sim 0.1$  K) between AMSU on NOAA-16 and -17 satellites from mid-troposphere to the stratosphere channels, although the uncertainties become larger for the surface channels due to surface non-uniformity and navigation errors. For infrared imagers such as AVHRR and MODIS, results using the SNO method show that the intersatellite calibration biases are mostly less than 0.5K, with an uncertainty less than 0.3 K (Cao and Heidinger, 2002; Wu et al., 2003). For the visible/near-infrared channels of AVHRR, preliminary results indicate that intersatellite calibration can perform better than  $\pm 5\%$ , which is the consensus value achievable with vicarious calibration (Rao, N., personal communication, 2000; Smith et al., 1988).

Second, intersatellite calibration studies of infrared sounders using the SNO method significantly improved our understanding of the spectral effect on satellite radiance biases in infrared atmospheric sounding (Cao et al., 2005). A small difference in the spectral response may mean that a channel is sensing a slightly different layer of atmosphere with a different temperature. This spectral response induced bias should be treated differently from those due to onboard blackbody differences. The SNO method is also very promising for inflight spectral calibration, especially as more hyperspectral sounders will be in space in the next few years (Cao and Ciren, 2004).

Third, the SNO method provides an important tool for the independent monitoring of instrument performance. Before the SNO method was developed, satellite radiometer calibration almost entirely depended on onboard calibration devices (infrared and microwave) or desert targets (in the visible/near infrared), with limited field campaigns

which are not sustainable. With the SNO method, the intersatellite calibration can be cross checked and compared routinely with small and probably acceptable uncertainties.

Finally, the SNO method also improved our understanding of navigation errors and geometric calibration, because they obviously affect the intersatellite calibration results. In addition, the SNO method improved our understanding of sensor artifacts such as striping. For example, MODIS striping in the 11 and 12  $\mu\text{m}$  channels becomes apparent when radiance values are subtracted from AVHRR radiances at the SNOs.

All these improvements have led to better accuracy and will continue to do so for the sensor data records (SDRs), which are the essential elements for all the satellite derived geophysical products. The results using the SNO method will help bias tuning in radiance assimilation in numerical weather forecast. Our studies suggest that in bias tuning, not only the bias amount, but also the cause of the bias has to be known, because as discussed previously, spectral induced biases should be treated differently than onboard blackbody biases. The SNO results will also help us improve the sea surface temperature retrievals, with a better understanding of the biases between satellite and buoy measurements. The SNO method is extremely important for the intersatellite calibration for climate studies, where a small difference in intersatellite bias can lead to different conclusions about global change. Recent progress made in the MSU study exemplifies the usefulness and potential of the SNO method (Zou et al., 2005). Last but not least, the biases discovered using the SNO method can become important feedbacks to instrument manufacturers and sensor data record (SDR) producers. For example, the SNO method has been used for comparing the blackbody performance between the MODIS on TERRA and AQUA (using the NOAA/AVHRR as

transfer radiometer) by the NASA MODIS characterization support team in the last few years.

NOAA's Polar Operational Environmental Satellites (POES) typically employs two spacecrafts in nearly circular sun synchronous orbits at nominal altitudes of 833 and 870 km. With their orbital planes approximately  $90^\circ$  apart, one has a 7:30 or 10:30 (for NOAA-17) local equator crossing time in descending node and the other a 13:40 local equator crossing time ascending node. They are referred to as AM (morning) and PM (afternoon) satellites. A sun-synchronous orbit ensures that the equator crossings occur at the same local time. This is desirable as it provides consistent scene illumination – a common mission requirement for many meteorological and terrestrial applications. Such orbits are achieved by placing the satellites at inclination angles of  $98.7^\circ$  to  $98.8^\circ$  so that the orbital planes will precess eastward about  $0.986^\circ$  per day to keep pace with the Earth's revolution around the sun (Rao et al., 1990). Since 1978, NOAA has successfully launched eleven polar-orbiting satellites (NOAA-6 to NOAA-17), with an average usable life of approximately five years in orbit for each. Since an AM satellite is generally at a lower altitude than the PM satellite, the AM satellite has a shorter orbital period. For example, the nominal orbital periods for the AM satellite NOAA-17 is 101 min, compared to 102 min for the PM satellite NOAA-16. In this report, simultaneous nadir overpasses (SNOs) for each succeeding pair of NOAA satellites (NOAA-6 to NOAA-17) from 1980 to 2003 are provided.

## **2. THE METHOD FOR PREDICTING THE SNO**

The intersection of the orbital plane of an Earth orbiting satellite with the surface of the Earth (or the satellite ground track) is a great circle. Every great circle of a sphere intersects

all other great circles of the sphere in exactly two points. Therefore, it is expected that the ground track of every pair of Earth orbiting satellites have two points of intersection. In the case of two polar-orbiting satellites, the two intersections always occur near the north and south poles. Although each satellite passes each intersection once an orbit, for most orbits the two satellites do not pass the same intersection at the same time. In fact, if both satellites are at the same altitude, they will have the same orbital period, and they should never pass the same orbital intersection (OI) at the same time (otherwise they will collide). It should be noted that orbital intersections (OIs) and SNOs (simultaneous nadir observations) are two different concepts. There are always exactly two orbital intersections (OIs) between two different orbital planes but since both satellites do not usually pass the orbital intersection at the same time, it may or may not qualify as an SNO event.

Kepler's third law implies that the higher the altitude of a satellite, the longer its orbital period. Satellites at higher altitudes have smaller angular velocities and therefore longer orbital periods. It follows then that as time goes by, the lower altitude satellite will eventually catch up with the high altitude satellite at the orbital intersections (OIs), thus creating an SNO (Simultaneous Nadir Overpass) (Figure 1). When this occurs, the radiometers from both satellites view the Earth and its atmosphere at the same place and same time from different altitudes. The difference in satellite altitudes does not affect the radiance comparison from the two radiometers on these satellites, as long as the areas within the field of view are essentially the same, because radiance is not a function of the distance of measurement. In addition, path radiance difference is negligible because there is little atmosphere between the two satellites at different altitudes.

The details of the mechanism and the algorithm for predicting the simultaneous nadir overpasses (SNOs) are described in Cao et al., 2004. The software used for the prediction is provided in Appendix A of the current paper. Here we summarize the basic principle of the

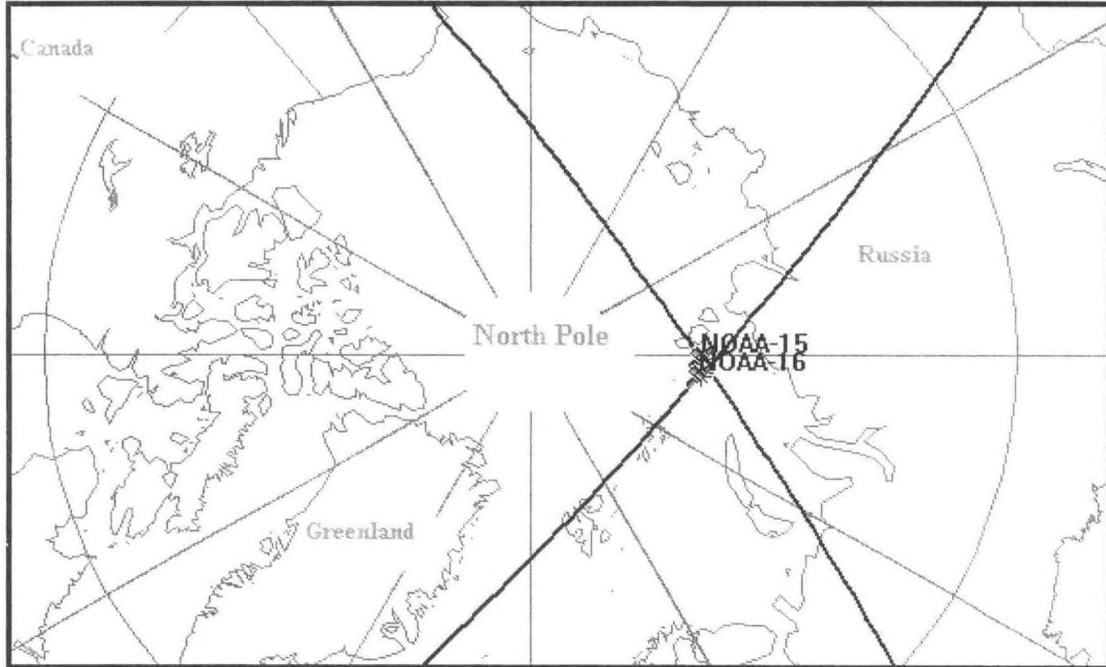


Figure 1. An example SNO between NOAA-15 and NOAA-16 (08/18/2002, 04:42:10 UTC, 79 deg N / 87 deg W)

SNO as follows: In general, assuming that two sun synchronous polar-orbiting satellites  $S_1$  and  $S_2$  operate at altitudes  $h_1$  and  $h_2$  ( $h_2 > h_1$ ) with orbital periods of  $\tau_1$  and  $\tau_2$  ( $\tau_2 > \tau_1$ ), an SNO between them occurs when the orbital period time difference ( $\tau_2 - \tau_1$ ) accumulates over time and this difference eventually amounts to  $\tau_2$ . In other words,  $S_1$ , having a higher velocity than  $S_2$ , eventually catches up with  $S_2$ . The number of orbits required for  $S_1$  to catch up with  $S_2$  is  $\tau_2 / (\tau_2 - \tau_1)$ . Converting number of orbits to number of days, we have the following formula for estimating the SNO occurrences between two satellites:

$$T = [\tau_2 / (\tau_2 - \tau_1)] \cdot 1/f_1 \quad (1)$$

Where,  $T$  = Time between successive SNOs (days)

$\tau_1$  = orbital period (min) for  $S_1$  at  $h_1$

$\tau_2$  = orbital period (min) for  $S_2$  at  $h_2$

$$\tau_2 > \tau_1 \text{ and } h_2 > h_1$$

$f_1$  = number of orbits per day for  $S_1$  ( $f_1 = 1440 \text{ (min per day)}/\tau_1$ ).

For example, in March 2003, the orbital periods for NOAA-16 and -17 are 101.9885 and 101.1722 minutes respectively, and the time between successive SNOs for the NOAA-17 and -16 is approximately once every 8.78 days. NOAA-17 and TERRA meet at their orbital intersections (OIs) more frequently about every 3 days because of the short orbital period for TERRA (98.83 minutes). It is worth noting that even two PM or two AM satellites, such as NOAA-14 and -16, have SNOs, although they occur much less frequently (e.g., more than two months) because of their similar altitudes. However, since their orbital periods are very similar, when the SNO event occurs, it tends to have multiple successive SNOs within several hours, in contrast to those that occur only once but more frequently. Such examples can be found for the SNOs between NOAA-16 and -14 (Appendix B). For example, on August 27, 2002 the SNOs between NOAA-16 and -14 occurred six times each near the north and south poles in the same day from 01:19:34 to 10:40:38 UTC. However, the next series of SNOs did not occur till more than two months later.

The precise location and time of the SNO between two satellites cannot be easily calculated with equations, because the satellite orbits are subjected to perturbations on a daily basis. Therefore, we opted to use the numerical method to find the approximate location and time of an SNO. This involves predicting the precise location of the two satellite nadirs at all



times during the prediction period with a given time step (1 second in this study), and then finding the minimum distance between the satellite nadirs (less than 100 km for this study). It should be noted that in this method, the “predicted SNO”, or the location and time when the minimum nadir distance occurs, may not be the true exact SNO. In fact, the distance between the predicted SNO and the true SNO varies as a function of the angle of orbital intersection between the two satellites as discussed in Section 3. Also, technically, since the precise SNO may not be found using this method, the exact time difference when the two satellites passed the true SNO point may also not be known. However, for practical purposes, the differences between the predicted and exact SNO location and time are small. Besides, the predicted SNO is only used for finding the particular orbit of level 1B data that contains the SNO. The true SNO is then found using the nadir pixel location and time information in the satellite level 1b data as discussed in Section 4.

To accurately predict the location of a satellite at a given time requires the use of orbital prediction models and appropriate input parameters. In this study we use the Simplified General Perturbation No. 4 (SGP4) (Hoots et al., 1988; Lane and Cranford, 1969), which is developed and used by the North American Aerospace Defense Command (NORAD) for tracking all satellites in space. The input to the SGP4 model is contained in a two-line-element (TLE) set, which consists of two 69-character lines of data which can be used together with NORAD's SGP4/SDP4 orbital model to determine the position and velocity of the associated satellite. TLEs are available for most satellites and are updated almost daily on the website: <http://celestrak.com> (note: starting from early 2005, public TLE access becomes limited for security reasons).

To predict Simultaneous Nadir Overpasses (SNOs) of two Earth orbiting satellites, the following algorithm is used:

- 1). Prepare the matching TLE pair for the two satellites: Since the precise satellite orbit is very dynamic, it is important to use the TLE pair with epochs (the time at which the orbital data were calculated) that are closest to the time of prediction to avoid errors. Also, ideally the TLEs for the two satellites should have the same epoch date. TLEs are usually released on a daily basis for all satellites, therefore in most cases for a given pair of TLEs, the prediction is only necessary for a one day period, -- until the TLE pair for the next day becomes available. However, prediction for a longer time period becomes necessary if the TLE for certain time periods are missing, in which case the prediction can be extended up to 10 days with reasonable accuracy. To predict the SNOs for an entire year, a series of TLE pairs must be prepared.

In version 2.0 of the SNO prediction software, stricter criteria are used for the predictions than those for the previous versions in order to improve the accuracy. This includes using an 1 second prediction interval, small TLE epoch differences, a shorter prediction period (< 5 days), and nadir distance less than 100 KM. While the version 2.0 of the prediction software in general produces more accurate predictions (Class I SNOs in Appendix B), it cannot be used when the TLEs are missing, which is the case for some satellites during certain time periods. In such cases, predictions using the previous version of software with a 30 second prediction interval and 10 day prediction period are used, and the results are provided in Appendix C (Class II SNOs) as complements to Class I SNOs.

- 2). Input the TLE of the first satellite to the SGP4 model and use its epoch as the starting date of prediction.

3). Given the time step (we used 1 s in SNO prediction algorithm version 2.0) and the time period of the prediction (in this study, we performed multiple runs with 2 day, 5 day, and 10 day prediction periods), run SGP4 at each time step to generate the dates, times, and locations of the satellite in latitude and longitude, and store them in an array. The 1 s time step is preferred to produce a precise location of the SNO. This corresponds to a ground step size of about 7 km for most polar-orbiting satellites.

4). Repeat steps 2 and 3 for the second satellite, using the same epoch and time step. This creates a list of coordinates that match those for the first satellite in time.

5). Step through the latitude/longitude pairs in time sequence, and compute the Earth (ground) distance between the nadir points of the two satellites during the prediction period with the great circle distance formula:

$$D = R \cos^{-1} [ \sin l_1 \sin l_2 + \cos l_1 \cos l_2 \cos (m_2 - m_1) ] \quad (2)$$

Where  $D$  = ground distance between the nadir points of the two satellites (km).

$R$  = mean Earth radius (6378 km)

$l_1$  = latitude of the first satellite (rad)

$l_2$  = latitude of the second satellite (rad)

$m_1$  = longitude of the first satellite (rad)

$m_2$  = longitude of the second satellite (rad)

Equation (2) is a simplified formula for estimating the ground distance, assuming a perfectly round Earth. The distance  $D$  at each time step shows how close the nadir points of these two satellites are on the ground. A sequential list of the distance  $D$  over a prediction period of

many orbits will show that the nadir points of the two satellites approach or depart from each other regularly with a repeating cycle of  $T$  days determined by equation (1). An example is shown in Figure 2, where two SNOs occurred between NOAA-16 and Terra during the period March 21 to 24, 2003.

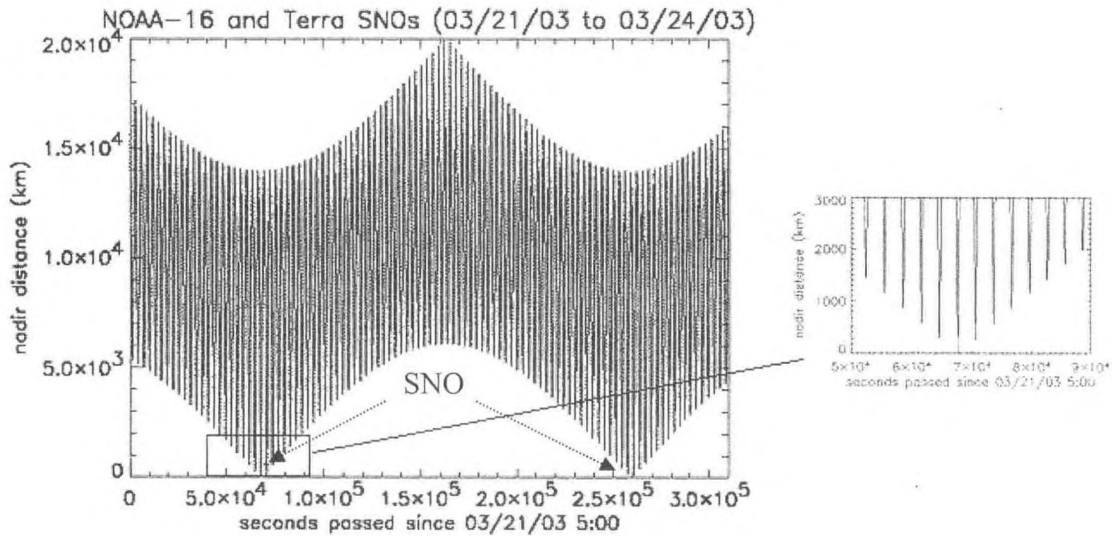


Figure 2. Nadir distances between NOAA-16 and Terra at all times from March 21 to 24, 2003 (computed with a 1 second interval; 1 day =  $8.64 \times 10^4$  s).

### 3. THE $\Delta$ RAAN (RIGHT ASCENSION OF ASCENDING NODE)

At the SNO, the ground tracks of the two satellites cross each other at an angle (Figure 3). This angle is useful for describing the relative orientation of the match-up data at the SNOs. It can be computed indirectly with the orbital information in the two-line-elements (TLEs). However, for convenience, we approximate this angle with the RAAN, or the "Right ascension of ascending node" (also called Longitude of Ascending Node). It is an angle measured at the center of the earth, from the vernal equinox to the point where the satellite goes across the equator in ascending node (Figure 4). This information is readily

available in the satellite two-line-elements (TLEs).  $\Delta\text{RAAN}$  is the difference of the RAAN angles for the two satellites, and it closely approximates the angle of intersection between the two ground tracks.

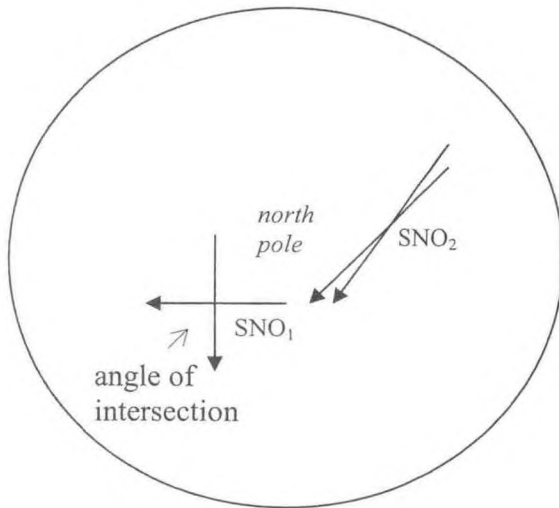


Figure 3. Types of Orbital Intersections and  $\Delta\text{RAAN}$  (not to scale)

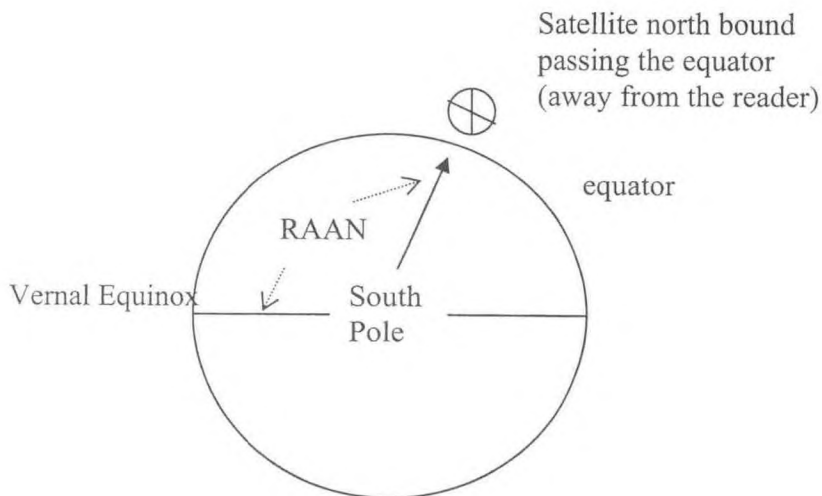


Figure 4. Definition of the Right Ascension of Ascending Node

If the  $\Delta\text{RAAN}$  is near 90 degrees ( $\text{SNO}_1$  in Figure 3), the two satellites cross each other at a right angle at a single point, and the distances between satellites increases significantly away from the SNO point. This is a typical case for a morning vs. afternoon satellites. On the other hand, if the  $\Delta\text{RAAN}$  is near zero degrees ( $\text{SNO}_2$  in Figure 3), the two satellites slowly approach and depart from each other. In this case, there may be a longer period of time during which the satellites observe the same place at the same time, and the SNO may not be a single point. It is also possible that in addition, if the two satellites have similar equator crossing times, the SNOs may occur at low latitudes.

In most cases, the  $\Delta\text{RAAN}$  is neither 90 nor 0 degrees. Between morning and afternoon satellites, this angle is typically large, while for two morning or two afternoon satellites, this angle is small. Table 1 shows the RAAN for NOAA and EOS satellites and the  $\Delta\text{RAAN}$  between each pair in December 2004. For example, NOAA-17 and TERRA have a  $\Delta\text{RAAN}$  of 1.9 (orbits are nearly parallel), while NOAA-15 and Aqua have a  $\Delta\text{RAAN}$  of 109.1 (closer to a right angle) at the time.

Figure 5 shows a case of NOAA-17 vs. Terra on November 8, 2004 at around 11:37:00 UTC. It shows that NOAA-17 and TERRA had ground tracks that were very close to each other for the hour from 11:00am to 12:00pm on Nov. 8. In a broad sense, all observations during this hour are nearly simultaneous, although the simultaneity occurs for observations slightly off nadir for both satellites most of the time. As predicted, the nadir distances between them were less than 300 km most of the time during this period, including those low latitude regions such as the tropics.

Table 1.  $\Delta$ RAAN for Selected NOAA and EOS satellites in December 2004

Satellite (RAAN)	NOAA-16 (291.8473)	NOAA-17 (50.5693)	TERRA (52.4458)	AQUA (275.2929)
NOAA-15 (348.4297)	56.6	297.9	296.0	109.1
NOAA-16 (291.8473)		241.3	239.4	16.6
NOAA-17 (50.5693)			1.9	224.7
TERRA (52.4458)				222.8

RAAN Source: two-line-elements on December 5, 2004

However, there is only one point of orbital intersection (OI) during this period. Figure 6 shows that the two ground tracks actually crossed each other at 11:37 am. This is the true OI which occurred at about 61 degrees north. Recall that OIs and SNOs (simultaneous nadir observations) are two different concepts. There are always exactly two OIs between two different orbital planes but since both satellites do not usually pass the OI at the same time, it may or may not qualify as an SNO event. For satellites with  $\Delta$ RAAN at angles other than zeros, SNO can only occur at the orbital intersections. For satellites with small  $\Delta$ RAAN angles, many observations may be nearly simultaneous despite not at the orbital intersections. Therefore, it is possible that such “quasi- SNO” data at low latitudes are useful if the criteria on nadir distance is not very strict. It should be noted that at the OI, the nadir distance between the two satellites are not necessarily the smallest among all the nearly SNO data available for the orbits with small  $\Delta$ RAAN. This is because when the first satellite reached the orbital intersection (OI), the other satellite was probably still at some distance to the intersection. But this can still be considered an SNO if that satellite reached the intersection within a short period of time (for example, within 30 seconds). Small nadir distances may

also occur at places other than the OIs in the near-parallel ground track situation.

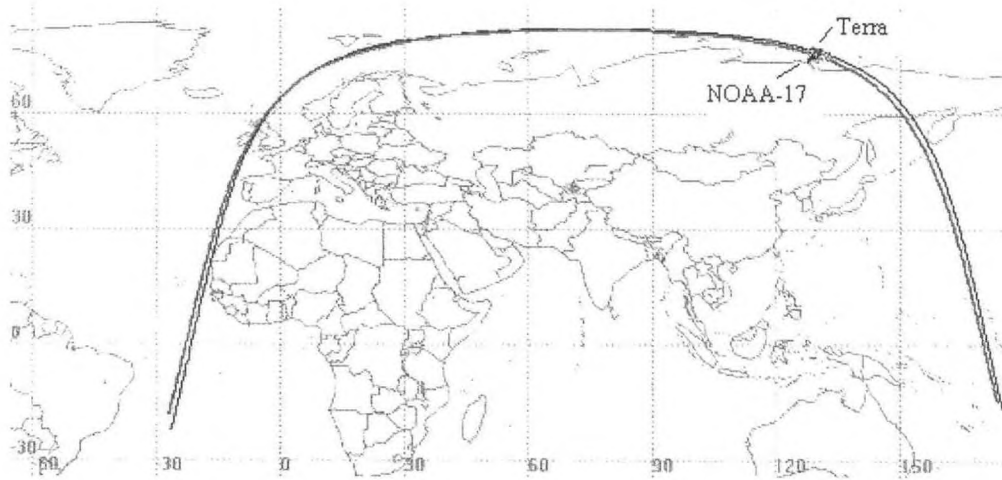


Figure 5. Orbits for NOAA-17 and Terra on November 8, 2004 (around 11:37:00 UTC)

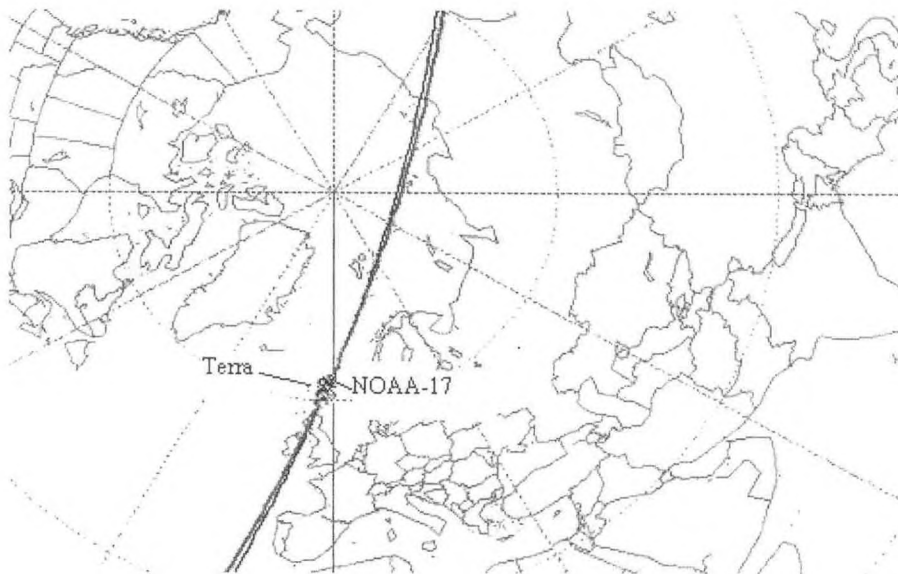


Figure 6. The Point of SNO for NOAA-17 and Terra (11:37:00UTC on November 8, 2004)



It should also be noted that the RAAN of each satellite changes over time due to the orbital drift of the satellite. Therefore, the  $\Delta$ RAAN also changes with time. For example, the  $\Delta$ RAAN between NOAA-15 and NOAA-14 decreased from  $\sim 71$  degrees in 1998 to 7 degrees by the end of 2002 (Appendix B), therefore changed the relative orientation of the match-up data sets at the SNOs during the period.

#### **4. SNO PREDICTION RESULTS FOR NOAA SATELLITES FROM 1980 TO 2003**

The predicted Simultaneous Nadir Overpasses (SNOs) for each pair of NOAA satellites from 1980 to 2003 are provided in Appendix B, in which the date, time, latitude and longitude are shown in the first 4 columns. The column labeled  $\delta$  is the estimated nadir distance between the two satellites at that time, while  $\epsilon$  represents the differences in epochs for the pair of the two-line-elements (TLEs) used. The  $\Delta$ RAAN approximates the angle of orbital intersection at the SNOs, as discussed previously. The SNOs are listed in chronological order for each pair of satellites, starting from NOAA-7 vs. NOAA-6, and ending at NOAA-17 vs. NOAA-16.

The predictions provided here are for the periods when the satellite data from both satellites were available, as defined in Table 2. Predictions involving NOAA-13 are not included in the list because its power failed 12 days after launch. Also, SNOs involving NOAA-8 are relatively few due to the short operating period of NOAA-8. Note that SNOs between AM and PM satellites occur far more often (such as between NOAA-7 and -6) than those between two AM or two PM satellites (such as NOAA-8 and -6) due to altitude differences.

The following summarizes the procedure for using the predicted SNOs in the Appendix B. This procedure has been used for the intersatellite calibration of both operational and historical satellite radiometers in the visible/near-infrared, infrared, and microwave. For more detailed information about this procedure, please see Cao et al., 2005.

Step 1: Obtain the Level 1b matching orbits that contain the SNOs for the two satellites based on the predicted time of the events listed in Appendix B.

Step 2: Find the exact SNO based on the location of the nadir pixel in the level 1b data. The nadir latitude/longitude and UTC time of all scan-lines for each satellite are extracted. The distances between each possible combination of nadir location pair are computed. An orbital intersection (OI) is found when the nadir distance is less than one pixel. The UTC time difference for the OI is also computed, and only those OIs with a time less than a time threshold is kept, which become the exact SNO points. Within one orbit, there may be two SNOs, one in the Arctic and the other in the Antarctic. The smaller the time threshold is, the better quality the SNO has, but the number of qualified SNOs will also decrease. Although this time threshold is somewhat arbitrary, we typically use 30 seconds as a criteria. The trade-offs between the time threshold and the number of SNOs are discussed in Zou et al., 2005.

Step 3. Select data subset to reduce the data volume. The subset is extracted near the SNO pixel, from which a number of rows and columns are extracted initially, along with the latitude/longitude for each pixel. This reduces the data size and facilitates the subsequent processing.

Step 4. Collocated the pixels. A pixel-by-pixel match between the two matching subsets is performed based on the ground distance between the pixels. The pixel collocation is optimized using various methods to reduce the impact of navigation errors.

Step 5. A nadir window is defined and the statistics of the radiance differences are generated and analyzed. A time series of the differences further reduce the uncertainties in the intercalibration.

Table 2. Data Availability for NOAA Polar Orbiting Satellites

Satellite	SSC# <sup>1</sup>	Launch date	Time of day	Instruments	Data available date range <sup>2</sup>
TIROS-N	11060	10/13/1978	PM	AVHRR/2 (4 chs), HIRS/2, MSU	10/19/1978 – 01/30/1980
NOAA-6 (A)	11416	06/27/1979	AM	AVHRR/2 (4 chs), HIRS/2, MSU	06/27/1979 – 03/05/1983 07/03/1984 – 11/16/1986
NOAA-7 (C)	12553	06/23/1981	PM	AVHRR/2 (5 chs), HIRS/2, MSU	08/19/1981 – 06/07/1986
NOAA-8 (E)	13923	03/28/1983	AM	AVHRR/2 (4 chs), HIRS/2, MSU	06/20/1983 – 06/12/1984 07/01/1985 – 10/31/1985
NOAA-9 (F)	15427	12/12/1984	PM	AVHRR/2 (5 chs), HIRS/2, MSU	02/25/1985 – 11/07/1988
NOAA-10 (G)	16969	09/17/1986	AM	AVHRR/2 (4 chs), HIRS/2, MSU	11/17/1986 – 09/16/1991
NOAA-11 (H)	19531	09/24/1988	PM	AVHRR/2 (5 chs), HIRS/2, MSU	11/08/1988 – 04/11/1995
NOAA-12 (D)	21263	05/14/1991	AM	AVHRR/2 (5 chs), HIRS/2, MSU	05/14/1991 – 12/14/1998
NOAA-13 (I)	22739	08/09/1993	PM	power failure after 12 days in orbit	08/09/1993 – 08/21/1993
NOAA-14 (J)	23455	12/30/1994	PM	AVHRR/2 (5 chs), HIRS/2, MSU	04/11/1995 – 08/14/2002
NOAA-15 (K)	25338	05/12/1998	AM	AVHRR/3 (6 chs), HIRS/3, AMSU	07/27/1998 - present
NOAA-16 (L)	26536	09/21/2000	PM	AVHRR/3 (6 chs), HIRS/3, AMSU	02/26/2001 - present
NOAA-17 (M)	27453	06/24/2002	AM	AVHRR/3 (6 chs), HIRS/3, AMSU	08/24/2002 - present

<sup>1</sup>SSC# = Space Surveillance Catalog number; <sup>2</sup>Sources: Kidwell 1995, <http://www.saa.noaa.gov>, and [daac.msfc.nasa.gov](http://daac.msfc.nasa.gov)

The software in C++ for predicting SNOs is listed in Appendix A, and can be compiled with the SGP4 library on all major computing platforms. The SNOs in Appendix B are limited to the NOAA satellites from 1980 to 2003. SNOs for future satellites will be generated when their two-line-elements become available. SNO updates for current operational NOAA satellites, along with SNOs for NOAA and EOS/Terra/Aqua satellites, can be found at the website: <http://www.orbit.nesdis.noaa.gov/smcd/spb/calibration/sno/>.

## 5. SUMMARY

Simultaneous nadir overpasses (SNOs) between pairs of NOAA satellites from NOAA-6 to NOAA-17 are generated with version 2.0 of the SNO prediction algorithm for the 1980 to 2003 period. These SNOs occurred in the polar regions, where the radiometers view the same place at the same time at nadir, providing excellent opportunities for intersatellite calibration. The SNOs are useful for monitoring the on-orbit performance and evaluating the calibration consistency of satellite radiometers in the visible/near infrared, infrared, and microwave, which are potentially useful for climate trending studies. The time and location, the nadir distance and epoch differences, as well as the approximate angle of intersection are included in the Appendix. The SNO algorithm and software in C++ are also provided in this report for those who are interested in predicting the SNOs.

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manuscript. In the revision, we took Dr. Powell's suggestions and discussed the significance and impact of the SNO method, which significantly improved the clarity and quality of the paper. We also thank Dr. Hui Xu of IMSG Inc. for the sample cross-comparison with earlier results. This study is partially funded by the Environmental Services Data and Information Management (ESDIM) of NOAA's GeoSpatial Data and Climate Services (GDCS) group, and the Product Systems Development and Implementation (PSDI) program of NOAA/NESDIS/OSD. The manuscript contents are solely the opinions of the authors and do not constitute a statement of policy, decision, or position on behalf of NOAA or the U. S. Government.

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## Appendix A. The C++ Program listing for predicting SNOs

```
/******  
Program name: SNO.cpp  
Predict Simultaneous Nadir Overpasses (SNOs) between two Polar Orbiting satellites  
Author: Changyong Cao, NOAA/NESDIS/ORA, April 15, 2003
```

Input: two separate tle files, one for each satellite, no header, two lines only.

Output: ASCII file SNOs.txt, which contains the time, location, and nadir distance between the satellite at the SNOs.

Compile: use make file with gcc on unix/linux

```
*****/
```

```
#include <stdio.h>  
#include <stdlib.h>  
#include <math.h>  
#include "sgp4sdp4.h" //use the SGP4 library  
#define TOL 150 //150 km or less apart.  
#define MAX 310000 //array size. Enough for 3 days if use 1 sec interval.
```

```
//the earth distance subroutine
```

```
extern float realdistance(float lat1,float lon1,float lat2,float lon2);
```

```
//main program starts here
```

```
int main(int argc, char **argv)  
{
```

```
//Initializing variables
```

```
char tle_tlefile1[] = " // TLE source file  
char tle_tlefile2[] = " // TLE source file  
tle_t tle1,tle2 ; // Two-line Orbital Elements for the satellite
```

```
vector_t zero_vector = {0,0,0,0}; //Zero vector for initializations  
vector_t vel1 = zero_vector; //Satellite position and velocity vectors  
vector_t pos1 = zero_vector;  
vector_t vel2 = zero_vector;  
vector_t pos2 = zero_vector;
```

```
//time and location variables
```

```
struct tm *utc; //Calendar date and time (UTC)  
time_t tm_interval,begintime;//, endtime;  
time_t t;  
float distance; //earth distance between nadir  
geodetic_t sat_geodetic;//Satellite's predicted geodetic position
```



```

double
tsince1,      // Time since epoch (in minutes)
tsince2,      // Time since epoch (in minutes)
jul_epoch1,   // Julian date of epoch
jul_epoch2,   // Julian date of epoch
jul_utc,      // Julian UTC date
sat_lat2, sat_lon2;
int flg; // Used for storing function return codes
char ephem[5]; // Ephemeris in use string
float lat[MAX],lon[MAX]; //latitude/longitude arrays
int i;
struct tm startdate;
char name[256];

int tle1skip,tle2skip;
FILE *outfile;
char outname[256];

//get the two TLE file names at the command line arguments
if (argc == 3)
{
    strcpy(tle_file1,argv[1]);
    strcpy(tle_file2,argv[2]);
    tle1skip=0;
    tle2skip=0;
} else //if not in the command line arguments
{
    //get the tle file names from user:
    printf("Enter the first TLE filename: \n");
    scanf("%s",name);
    strcpy(tle_file1,name);
    tle1skip=0;

    printf("Enter the second TLE filename: \n");
    scanf("%s",name);
    strcpy(tle_file2,name);
    tle2skip=0;
}

//output is "SNOs.txt"
sprintf(outname,"SNOs.txt");
outfile=fopen(outname,"w");
fprintf(outfile,"Simultaneous Nadir Overpasses (SNOs) between %s and
%s\n",tle_file1,tle_file2);

```

```

//Input from the TLE files:
flg = Input_Tle_Set(tle_file1, &tle1,tle1skip);//Input one (first!) TLE set from file
if( flg == -1 ) {printf(" File open failed - Exiting!\n");exit(-1);}
if( flg == -2 ) {printf("TLE1 set bad - Exiting!\n");exit(-2);}
else printf("TLE1 ok\n");

//Set the time period:
//UTC_Calendar_Now(&utc);
//use the epoch day and time in the TLE
begintime=time(0);
t=begintime;
utc=gmtime(&t);
jul_epoch1 = Julian_Date_of_Epoch(tle1.epoch);
Calendar_Date(jul_epoch1, &startdate) ;
fprintf(outfile,"TLE Epoch: %d %d %d.
",startdate.tm_year,startdate.tm_mon,startdate.tm_mday);
fprintf(outfile,"Predictions for the next 20 days:\n");
fprintf(outfile,"\n  Date   Time Sat1 Lat/Lon Sat2 Lat/Lon  Nadir Distance
(km)\n");
utc->tm_mon=startdate.tm_mon-1;
utc->tm_mday=startdate.tm_mday;
// utc->tm_mday=startdate.tm_mday-15; //in case need to go back 15 days from epoch
utc->tm_hour=0;
utc->tm_wday = 0;
utc->tm_yday = 0;
utc->tm_isdst = 0;
utc->tm_hour=0;
utc->tm_sec = 0;
utc->tm_min = 0;
utc->tm_year=startdate.tm_year-1900; //CC 3/13/2003 date conversion
begintime=mktime(utc);
t = begintime;
tm_interval=1; //1 second step size

printf("For year: %d month: %d\n",startdate.tm_year,startdate.tm_mon);
ClearFlag(ALL_FLAGS);
select_ephemeris(&tle1);

/*****
For the first satellite, predict the lat/lon at the given time interval (1 second)
*****/
i=0;
while (i<MAX)
{

```

```

t=t+tm_interval;
utc=gmtime(&t);
utc->tm_year+=1900;
//printf("%d %d\n",utc->tm_year,startdate.tm_year);
utc->tm_mon+=1;

/* Get UTC calendar and convert to Julian */
jul_utc = Julian_Date(utc);
/* Convert satellite's epoch time to Julian
and calculate time since epoch in minutes */
jul_epoch1 = Julian_Date_of_Epoch(tle1.epoch);
jul_epoch2 = Julian_Date_of_Epoch(tle2.epoch);
tsince1 = (jul_utc - jul_epoch1) * xmnnpda;
tsince2 = (jul_utc - jul_epoch2) * xmnnpda;

//Satellite locations
/* !Clear all flags! Before calling a different ephemeris or changing the TLE set,
flow control flags must be cleared in main(). */

//Copy the ephemeris type in use to ephem string
if( isFlagSet(DEEP_SPACE_EPHEM_FLAG) ) strcpy(ephem,"SDP4");
else strcpy(ephem,"SGP4");

// Call NORAD SGP4 routines according to deep-space flag
if( isFlagSet(DEEP_SPACE_EPHEM_FLAG) ) SDP4(tsince1, &tle1, &pos1,
&vell);
else SGP4(tsince1, &tle1, &pos1, &vell);

// Scale position and velocity vectors to km and km/sec
Convert_Sat_State( &pos1, &vell );
// Calculate satellite Lat North, Lon East and Alt. */
Calculate_LatLonAlt(jul_utc, &pos1, &sat_geodetic);
lat[i]=Degrees(sat_geodetic.lat);
lon[i] = Degrees(sat_geodetic.lon);
i++;
} //END WHILE LOOP

/*****
For the second satellite, predict the lat/lon at the given time interval (1 second)
*****/
flg = Input_Tle_Set(tle_file2, &tle2,tle2skip); //get the 2nd TLE set from another
file.
if( flg == -1 ){printf(" File open failed - Exiting!\n");exit(-1);}
if( flg == -2 ){printf("2nd TLE set bad - Exiting!\n");exit(-2);}

```

```

else printf("TLE2 ok!\n");
//Clear all flags! Before calling a different ephemeris or changing the TLE set,
//flow control flags must be cleared in main().
ClearFlag(ALL_FLAGS);
select_ephemeris(&t1e2);
t=begin_time; //Must be the same as that for the first satellite to ensure simultaneity!!

i=0;
while (i<MAX)
{
t=t+tm_interval;
utc=gmtime(&t);
utc->tm_year+=1900;
utc->tm_mon+=1;
/* Get UTC calendar and convert to Julian */
jul_utc = Julian_Date(utc);
/* Convert satellite's epoch time to Julian
and calculate time since epoch in minutes */
jul_epoch2 = Julian_Date_of_Epoch(t1e2.epoch);
tsince2 = (jul_utc - jul_epoch2) * xmnpsda;

//Copy the ephemeris type in use to ephem string
if( isFlagSet(DEEP_SPACE_EPHEM_FLAG) ) strcpy(ephem,"SDP4");
else strcpy(ephem,"SGP4");

// Call NORAD routines according to deep-space flag
if( isFlagSet(DEEP_SPACE_EPHEM_FLAG) ) SDP4(tsince2, &t1e2, &pos2,
&vel2);
else SGP4(tsince2, &t1e2, &pos2, &vel2);
//Scale position and velocity vectors to km and km/sec
Convert_Sat_State( &pos2, &vel2 );
//Calculate satellite Lat North, Lon East and Alt.
Calculate_LatLonAlt(jul_utc, &pos2, &sat_geodetic);
sat_lat2 = Degrees(sat_geodetic.lat);
sat_lon2 = Degrees(sat_geodetic.lon);

//Compute the real distance between these two satellites:
distance = realdistance(lat[i],lon[i],sat_lat2,sat_lon2);
//printf("Distance: %f\n",distance);
//printf("%f %f %f %f\n",sat_lat,sat_lon,sat_lat2,sat_lon2);
if (distance < TOL) //if they are very close to each other, print out
fprintf(outfile," %02d/%02d/%04d %02d:%02d:%02d (%5.1f %5.1f) (%5.1f,%5.1f)
%6.0f\n",
utc->tm_mon,utc->tm_mday,utc->tm_year,utc->tm_hour,utc->tm_min, utc-
>tm_sec,

```

```

        lat[i], lon[i],sat_lat2,sat_lon2,distance);
    i++;
} //END OF WHILE LOOP
fclose(outfile);
return(0);
} //END OF MAIN

```

```

/*****

```

Subroutine: Computing the earth distance given the latitude/longitude of two points on the earth.

Author: Changyong Cao, NOAA/NESDIS/ORA

```

*****/

```

```

#define earth_radius 6378 //km
#define PI 3.14159
#include <math.h>

```

```

float realdistance(float lat,float lon,float _lat,float _lon)
{
    float temp;

    //convert all to radians:
    lat=lat*PI/180.0;
    lon=lon*PI/180.0;
    _lat=_lat*PI/180.0;
    _lon=_lon*PI/180.0;

    temp=sin(lat)*sin(_lat) + cos(lat)*cos(_lat)*cos(_lon-lon);
    temp=acos(temp);
    temp=temp*earth_radius;
    if (temp<0) temp=9999;
    return temp;
} //end of realdistance subroutine

```

```

/*****

```

The Makefile for SNO.cpp

```

*****/

```

```

SHELL = /bin/sh
CC = gcc -Wall -O3

```

```

#vpath %.c ./src

```

```
#vpath %.h ./src
```

```
objects = sno.o sgp4sdp4.o sgp_in.o sgp_math.o sgp_obs.o sgp_time.o solar.o distance.o
```

```
sno : $(objects)
```

```
$(CC) -lm -o main $(objects)
```

```
$(objects) : sgp4sdp4.h
```

```
.HOUSKEEPING : clean
```

```
clean :
```

```
-rm -f *.o *~
```



**Appendix B. Class I SNOs for NOAA Satellites  
(NOAA-6 to NOAA-17)**

Note:

1.  $\delta$  = nadir ground distance between the satellites;  $\epsilon$  = TLE epoch difference in days;  $\Delta$ RAAN = difference in the right ascension of ascending nodes.

2. Class I SNOs have stricter criteria and better accuracy (1 second prediction interval; small  $\epsilon$ ; prediction period < 5 days; nadir distance < 100km). Class II SNOs, with a 30 second prediction interval and 10 day prediction period, are complements to the Class I SNOs for time periods with missing TLEs.

**Class I SNOs between NOAA-07 and NOAA-06**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
08/16/1981	16:31:26	-79.0	97.0	18	-1.83	-78.8
08/25/1981	08:00:10	-79.2	-137.0	97	-0.15	-77.0
08/25/1981	08:51:02	78.8	33.3	30	-0.15	-77.0
09/03/1981	00:19:34	79.1	159.4	51	0.27	-76.6
09/03/1981	01:10:21	-78.6	-30.2	81	0.27	-76.6
09/11/1981	16:38:43	-78.9	95.9	5	1.81	-75.0
09/20/1981	08:06:54	-79.2	-138.0	68	-1.49	-78.2
09/20/1981	08:57:39	78.7	32.4	54	-1.49	-78.2
09/29/1981	00:25:35	79.0	158.7	19	0.47	-76.2
10/16/1981	08:11:43	-79.1	-138.4	44	0.43	-76.0
10/16/1981	09:02:27	78.6	31.9	89	0.43	-76.0
10/25/1981	00:29:41	78.9	158.4	15	0.64	-75.7
11/11/1981	08:14:12	-79.0	-138.4	21	0.08	-76.1
11/19/1981	23:40:36	-79.3	-12.0	93	0.14	-76.0
11/20/1981	00:31:25	78.8	159.0	50	0.14	-76.0
11/28/1981	15:57:39	79.0	-74.0	6	0.05	-76.0
12/15/1981	23:40:21	-79.0	-10.0	24	0.32	284.5
12/24/1981	15:06:00	-79.2	117.7	64	-0.09	284.2
12/24/1981	15:56:52	78.7	-71.9	70	-0.09	284.2

01/02/1982	07:22:27	78.9	55.3	11	0.13	284.5
01/10/1982	22:47:51	79.1	-177.0	37	0.05	284.5
01/10/1982	23:38:39	-78.7	-6.8	94	0.05	284.5
01/19/1982	14:13:09	79.2	-49.4	77	-0.02	284.6
01/19/1982	15:03:59	-78.8	120.9	55	-0.02	284.6
01/19/1982	15:04:00	-78.8	120.9	49	0.00	284.6
01/28/1982	06:29:17	-79.0	-111.3	7	-0.01	284.7
02/05/1982	21:54:27	-79.2	16.1	40	-0.01	284.8
02/05/1982	22:45:10	78.7	-173.4	91	-0.01	284.8
02/23/1982	05:34:51	79.0	82.3	9	-0.86	-75.8
03/03/1982	20:59:32	79.1	-149.8	34	1.72	-73.2
03/03/1982	21:50:23	-78.7	20.4	89	1.72	-73.2
03/12/1982	12:24:00	79.3	-21.9	68	0.12	-74.6
03/12/1982	13:14:48	-78.9	148.6	54	0.12	-74.6
03/21/1982	04:39:07	-79.0	-83.4	15	0.41	-74.2
03/29/1982	20:03:18	-79.1	44.6	23	-1.62	-76.1
04/24/1982	18:15:03	-79.4	69.8	94	0.12	-74.0
04/24/1982	19:05:54	78.9	-119.3	43	0.12	-74.0
05/03/1982	10:29:37	79.0	9.2	24	-0.66	-74.6
05/12/1982	01:53:13	79.1	138.2	14	0.07	-73.8
05/20/1982	17:16:47	79.1	-92.7	16	1.74	-72.0
06/07/1982	00:03:44	79.0	165.9	29	1.02	-72.5
06/15/1982	14:36:25	-79.4	124.9	88	1.17	-72.1
06/15/1982	15:27:07	79.0	-64.4	46	1.17	-72.1
07/11/1982	12:46:17	-79.2	154.7	6	-0.08	-72.9
07/20/1982	03:18:39	79.4	114.7	81	0.68	-72.1
07/20/1982	04:09:27	-79.1	-75.1	44	0.68	-72.1
07/28/1982	18:41:46	79.3	-114.6	23	1.16	-71.5
08/15/1982	00:37:02	-79.4	-23.9	46	0.00	-72.2
08/15/1982	01:27:54	78.9	146.7	95	0.00	-72.2
09/09/1982	21:04:10	-79.5	28.1	91	0.03	-71.8
09/09/1982	21:54:59	79.1	-160.9	50	0.03	-71.8
09/09/1982	21:55:00	79.1	-161.2	50	0.03	-71.8
09/18/1982	12:26:57	-79.3	159.7	3	-1.82	-73.4
10/05/1982	17:30:43	-79.5	81.8	90	-0.08	-71.4
10/05/1982	18:21:27	79.1	-107.5	48	-0.08	-71.4
11/26/1982	10:21:01	-79.5	-169.7	45	1.32	-69.0
11/26/1982	11:11:48	79.1	1.1	90	1.32	-69.0
12/22/1982	05:54:01	79.7	75.8	100	-0.09	290.2



12/22/1982	06:44:43	-79.3	-113.6	27	-0.09	290.2	01/01/1986	18:43:19	80.9	-113.7	55	0.62	330.7
12/30/1982	21:15:33	79.3	-151.5	24	-1.20	289.3	01/18/1986	21:05:25	-80.9	29.7	90	0.05	-29.1
01/08/1983	11:46:11	-79.4	170.5	7	0.35	291.0	01/18/1986	21:56:13	80.8	-158.8	50	0.05	-29.1
01/25/1983	16:47:26	-79.4	95.1	3	-0.93	290.1	02/05/1986	00:18:17	-80.9	-16.1	2	-0.02	-28.3
02/03/1983	07:17:58	79.4	57.8	9	0.13	291.4	02/22/1986	02:40:22	80.9	128.4	7	0.11	-27.4
02/11/1983	21:48:31	-79.4	20.0	2	-0.73	-69.3	03/02/1986	16:16:44	80.9	-73.7	71	-0.44	-27.4
03/09/1983	17:19:43	79.4	-92.3	23	1.61	-66.4	03/11/1986	05:02:23	-80.9	-89.5	68	0.04	-26.6
04/13/1983	02:30:04	-79.7	-51.8	55	1.26	-65.9	03/28/1986	07:24:18	80.9	55.5	53	-0.66	-26.5
04/13/1983	03:20:53	79.3	119.1	81	1.26	-65.9	03/28/1986	08:15:05	-80.8	-132.2	98	-0.66	-26.5
06/12/1983	06:18:50	79.7	71.7	40	-1.82	-67.3	06/21/1986	18:22:39	80.9	-108.1	14	0.04	-21.5
06/12/1983	07:09:39	-79.4	-117.7	86	-1.82	-67.3	08/11/1986	23:45:55	-80.9	-8.8	53	0.04	-18.8
08/11/1983	08:24:06	-79.8	-139.1	27	-0.43	-64.4	10/02/1986	03:27:19	80.8	109.3	80	-0.03	-16.3
10/27/1983	12:03:33	80.0	-15.1	87	1.51	-60.3	10/02/1986	04:18:01	-80.9	-77.5	90	-0.03	-16.3
10/27/1983	12:54:24	-79.7	155.7	47	1.51	-60.3	10/27/1986	17:43:36	-80.8	75.5	46	-0.11	-15.0
11/30/1983	19:28:33	-79.8	57.0	42	-0.78	-61.5	10/27/1986	18:34:10	80.8	-114.8	25	-0.64	-15.4
02/07/1984	07:44:51	80.0	51.4	20	-0.92	-59.4	11/05/1986	06:28:28	80.8	67.3	41	-0.59	-15.0
02/07/1984	08:35:37	-79.7	-138.0	98	-0.92	-59.4	11/05/1986	05:37:56	-80.8	-103.2	38	0.05	-14.3
03/04/1984	00:39:28	80.1	157.8	25	0.27	-57.4	11/05/1986	06:28:52	80.8	66.6	38	-0.56	-14.8
03/12/1984	14:17:36	80.1	-47.0	34	1.59	-55.9	11/13/1986	19:14:10	-80.8	53.9	14	-0.88	-14.9
04/24/1984	11:18:20	-80.0	-179.7	52	-0.43	-56.3	11/13/1986	20:04:41	80.8	-136.0	80	-0.86	-14.8
06/23/1984	10:42:31	-80.3	-173.6	60	1.16	-52.7	11/13/1986	18:23:24	80.7	-116.9	99	-0.01	-13.9
09/08/1984	14:10:42	80.2	-42.4	48	1.40	-49.5	11/30/1986	20:44:30	-80.7	28.3	54	-0.09	-13.1
01/23/1985	17:47:21	80.6	-100.5	97	1.32	-44.2	11/30/1986	20:44:32	-80.6	27.6	54	-0.09	-13.1
01/23/1985	18:38:03	-80.4	70.8	35	1.32	-44.2	11/30/1986	19:53:54	80.7	-138.9	50	-0.09	-13.1
03/24/1985	21:19:46	-80.5	30.7	44	-0.67	-43.6	12/09/1986	09:29:42	80.7	17.9	7	-0.38	-13.1
04/28/1985	05:28:45	-80.6	-92.5	18	1.95	-39.5	12/09/1986	08:39:10	-80.7	-149.9	14	-0.38	-13.1
05/06/1985	19:05:34	-80.7	60.8	68	-1.00	-42.0	12/26/1986	10:09:09	-80.8	-169.0	93	0.05	348.3
05/06/1985	19:56:22	80.5	-128.2	61	-1.00	-42.0							
06/01/1985	13:37:28	-80.6	145.4	8	0.77	-39.1							
08/17/1985	17:49:19	-80.8	81.6	10	1.87	-34.6							
09/03/1985	21:02:33	-80.8	32.2	44	0.74	-35.0							
09/03/1985	21:53:20	80.7	-156.9	77	0.74	-35.0	11/25/1983	06:16:05	-80.8	-50.2	70	-0.56	2.4
10/08/1985	03:28:55	-80.9	-65.9	96	0.07	-33.9	11/25/1983	07:06:41	80.8	117.5	43	-0.56	2.4
10/08/1985	04:19:43	80.7	107.1	96	0.07	-33.9	11/25/1983	07:06:47	80.9	115.4	42	-0.56	2.4
10/25/1985	06:42:04	-80.9	-114.0	90	-1.51	-34.8	11/25/1983	07:06:53	81.0	113.2	42	-0.56	2.4
11/02/1985	20:18:37	-80.9	42.1	80	0.06	-32.7	11/25/1983	07:57:16	-80.6	-73.2	8	-0.56	2.4
11/19/1985	23:31:42	-80.8	-4.9	28	-0.60	-32.7	11/25/1983	08:47:44	80.4	97.2	22	-0.56	2.4
11/28/1985	13:08:11	-80.8	152.0	4	-0.58	-32.2	11/25/1983	08:47:50	80.6	95.2	22	-0.56	2.4
12/15/1985	16:21:09	-80.8	105.8	71	-0.09	329.1	11/25/1983	08:47:56	80.7	93.1	22	-0.56	2.4

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Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
11/25/1983	06:16:05	-80.8	-50.2	70	-0.56	2.4
11/25/1983	07:06:41	80.8	117.5	43	-0.56	2.4
11/25/1983	07:06:47	80.9	115.4	42	-0.56	2.4
11/25/1983	07:06:53	81.0	113.2	42	-0.56	2.4
11/25/1983	07:57:16	-80.6	-73.2	8	-0.56	2.4
11/25/1983	08:47:44	80.4	97.2	22	-0.56	2.4
11/25/1983	08:47:50	80.6	95.2	22	-0.56	2.4
11/25/1983	08:47:56	80.7	93.1	22	-0.56	2.4

11/25/1983	09:38:23	-80.4	-94.9	58	-0.56	2.4	11/24/1986	11:21:51	-81.4	-151.3	70	-0.00	15.9
11/25/1983	09:38:29	-80.5	-96.9	58	-0.56	2.4	11/24/1986	12:12:23	81.4	16.0	87	-0.00	15.9
11/25/1983	09:38:35	-80.7	-98.9	58	-0.56	2.4							
11/25/1983	09:38:41	-80.8	-101.0	58	-0.56	2.4							
11/25/1983	10:28:52	80.2	75.0	86	-0.56	2.4							
01/08/1984	00:23:11	-81.1	31.8	85	1.76	5.3							
01/08/1984	00:23:17	-81.2	29.6	85	1.76	5.3							
01/08/1984	01:13:54	81.0	-160.0	40	1.76	5.3							
01/08/1984	02:04:18	-80.9	10.5	22	1.76	5.3							
01/08/1984	02:04:24	-81.0	8.3	21	1.76	5.3							
01/08/1984	02:54:57	80.8	-179.9	24	1.76	5.3							
01/08/1984	02:55:00	80.8	179.0	24	1.76	5.3							
01/08/1984	02:55:06	81.0	176.8	24	1.76	5.3							
01/08/1984	03:45:31	-80.8	-13.1	43	1.76	5.3							
01/08/1984	04:36:10	80.7	156.4	88	1.76	5.3							
04/04/1984	05:00:01	81.3	135.3	70	1.40	6.0							
04/04/1984	05:50:31	-81.2	-54.0	36	1.40	6.0							
04/04/1984	06:41:06	81.2	114.9	6	1.40	6.0							
04/04/1984	07:31:38	-81.1	-75.2	29	1.40	6.0							
04/04/1984	08:22:14	81.1	93.2	59	1.40	6.0							
04/04/1984	09:12:51	-81.0	-98.8	93	1.40	6.0							
04/04/1984	09:12:57	-81.1	-101.1	93	1.40	6.0							
10/09/1985	03:03:09	-81.4	-26.0	88	0.07	11.8							
10/09/1985	03:53:45	81.4	143.1	44	0.07	11.8							
10/09/1985	04:44:19	-81.4	-48.4	22	0.07	11.8							
10/09/1985	05:34:56	81.4	120.3	23	0.07	11.8							
10/09/1985	06:25:32	-81.4	-72.0	44	0.07	11.8							
10/09/1985	07:16:09	81.4	96.8	91	-0.07	11.7							
12/31/1985	15:43:59	81.4	-37.6	92	-0.00	12.7							
12/31/1985	16:34:30	-81.4	130.9	61	-0.00	12.7							
12/31/1985	18:15:42	-81.4	107.7	6	-0.00	12.7							
12/31/1985	19:06:21	81.4	-83.3	42	-0.00	12.7							
12/31/1985	17:25:11	81.4	-60.7	23	-0.00	12.7							
12/31/1985	19:56:54	-81.4	84.7	75	-0.00	12.7							
12/31/1985	15:44:00	81.4	-37.5	82	0.56	13.2							
11/24/1986	07:59:29	-81.4	-105.7	66	-0.00	15.9							
11/24/1986	08:49:59	81.4	62.4	50	-0.00	15.9							
11/24/1986	09:40:40	-81.4	-128.5	2	-0.00	15.9							
11/24/1986	10:31:11	81.4	39.2	18	-0.00	15.9							
07/06/1983	01:22:19	79.7	149.8	67	1.72	67.6							
07/06/1983	02:13:13	-79.4	-45.2	38	1.72	67.6							
07/16/1983	16:18:28	79.7	-73.8	70	-1.32	64.5							
07/16/1983	17:09:21	-79.4	90.6	46	-1.32	64.5							
07/16/1983	17:09:25	-79.5	91.5	5	0.58	66.3							
07/16/1983	18:00:13	79.3	-103.1	83	0.93	66.7							
09/07/1983	22:22:43	79.7	-164.7	50	1.36	66.4							
09/07/1983	23:13:27	-79.4	-0.1	59	1.36	66.4							
10/20/1983	12:39:12	-79.7	161.3	44	1.99	66.4							
10/20/1983	13:29:56	79.3	-34.5	91	1.99	66.4							
10/31/1983	04:25:50	79.6	103.7	2	-0.14	64.0							
10/31/1983	05:16:44	-79.3	-91.2	98	-0.14	64.0							
11/10/1983	19:21:42	79.9	-117.8	92	0.38	64.5							
11/10/1983	20:12:36	-79.6	46.9	16	0.38	64.5							
12/02/1983	02:54:59	79.8	128.4	63	0.79	-295.5							
12/02/1983	03:45:49	-79.4	-67.5	66	0.79	-295.5							
12/02/1984	08:56:48	79.9	38.9	83	-0.26	-297.5							
01/24/1984	09:47:33	-79.7	-155.9	13	-0.26	-297.5							
02/14/1984	16:29:33	79.9	-73.8	88	0.08	62.4							
02/14/1984	17:20:24	-79.7	91.5	4	0.08	62.4							
03/17/1984	16:39:09	80.0	-75.8	85	1.65	63.4							
03/17/1984	17:30:03	-79.7	88.7	23	1.65	63.4							
05/10/1984	02:52:33	-79.8	-50.4	19	-0.27	60.3							
05/10/1984	03:43:26	79.6	114.5	91	-0.27	60.3							
05/20/1984	19:29:14	-79.9	60.7	19	0.86	61.2							
06/11/1984	04:42:30	-79.9	-76.8	41	-0.12	59.7							
02/23/1985	16:22:12	80.1	-70.8	32	1.99	55.1							
05/31/1985	14:40:50	80.3	-43.1	25	0.31	50.5							
05/31/1985	15:31:34	-80.1	121.8	80	0.31	50.5							
07/24/1985	11:49:03	80.3	-0.5	18	-0.77	47.5							
08/15/1985	00:23:40	80.5	173.7	87	0.63	48.1							
08/15/1985	01:14:30	-80.2	-22.7	63	0.63	48.1							
09/16/1985	08:06:16	-80.5	-122.5	53	0.02	46.5							

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09/16/1985	08:57:08	80.3	42.5	41	0.02	46.5
10/18/1985	15:48:50	80.5	-58.6	27	1.23	46.6
10/18/1985	16:39:37	-80.3	106.7	51	1.23	46.6
10/29/1985	10:06:01	80.5	28.1	59	1.15	46.2
10/29/1985	10:56:50	-80.4	-166.3	10	1.15	46.2
11/30/1985	17:48:25	-80.6	92.7	57	0.31	44.2
11/30/1985	18:39:09	80.3	-103.3	71	0.31	44.2

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Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
01/06/1985	21:18:26	79.2	-159.7	40	0.38	288.9
01/21/1985	18:36:37	79.4	-120.2	2	0.55	289.4
07/04/1985	12:54:25	79.7	-36.8	59	0.48	-66.7
07/04/1985	13:45:18	-79.4	134.0	87	0.48	-66.7
09/02/1985	00:23:34	79.7	151.7	22	-0.38	-66.0
09/09/1985	11:02:22	79.6	-6.5	40	0.34	-65.1
09/16/1985	20:50:18	-79.9	23.6	65	-0.31	-65.6
10/09/1985	03:55:51	79.8	98.8	11	-0.51	-65.1
10/31/1985	11:01:16	-79.8	172.4	8	-1.12	-65.0
12/15/1985	00:20:56	80.1	149.7	96	-1.85	295.5
12/15/1985	01:11:45	-79.6	-37.8	97	-1.85	295.5
02/05/1986	00:18:44	-80.1	-29.9	98	0.76	299.6
06/18/1986	17:04:34	-80.3	78.7	83	-2.00	-58.8
08/24/1986	12:35:11	80.3	-32.7	23	-0.42	-54.9
09/15/1986	18:48:16	80.3	-126.0	29	-0.11	-53.9
09/30/1986	15:13:50	-80.2	108.8	23	-0.02	-53.3
10/22/1986	21:27:09	-80.3	14.6	7	-0.16	-52.6
10/22/1986	22:17:46	80.1	-175.6	78	-1.13	-53.5
10/30/1986	07:14:31	80.4	47.3	20	0.05	-52.1
10/30/1986	08:05:07	-80.4	-145.7	36	0.61	-51.6
10/30/1986	08:05:18	-80.1	-142.0	99	0.29	-51.8
11/06/1986	17:52:38	80.2	-109.3	86	0.18	-51.7
11/06/1986	17:52:26	80.4	-112.8	51	0.33	-51.6
11/06/1986	18:43:15	-80.2	57.9	75	0.33	-51.6
11/14/1986	04:30:33	80.2	90.3	55	-0.44	-52.0
11/14/1986	03:39:59	-80.3	-78.8	12	-0.01	-51.6
11/14/1986	03:40:00	-80.4	-79.0	12	-0.07	-51.6
11/21/1986	13:26:52	80.4	-46.5	46	0.20	-51.1

11/21/1986	13:27:15	80.4	-46.6	46	0.00	-51.3
11/29/1986	00:05:20	80.2	156.8	56	-0.09	-51.2
11/29/1986	00:05:09	80.5	152.9	82	1.34	-49.7
11/29/1986	00:56:00	-80.2	-35.0	90	1.34	-49.7
12/06/1986	10:43:14	80.3	-3.8	22	0.81	-50.1
12/06/1986	09:52:41	-80.4	-171.7	4	-0.00	-50.7

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Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
04/30/1985	16:07:24	80.8	-102.1	72	0.21	-27.4
04/30/1985	16:58:24	-80.9	65.0	76	0.21	-27.4
04/30/1985	17:49:25	80.8	-126.1	23	0.21	-27.4
04/30/1985	18:40:25	-80.8	41.0	27	0.21	-27.4
04/30/1985	19:31:26	80.7	-150.1	26	0.21	-27.4
04/30/1985	20:22:26	-80.7	16.9	22	0.21	-27.4
04/30/1985	21:13:27	80.7	-174.2	75	0.21	-27.4
04/30/1985	22:04:27	-80.7	-7.2	71	0.21	-27.4
08/20/1985	13:48:33	-80.8	114.1	94	-0.07	-29.8
08/20/1985	14:39:31	80.8	-77.6	52	-0.07	-29.8
08/20/1985	15:30:34	-80.8	90.0	46	-0.07	-29.8
08/20/1985	16:21:31	80.7	-101.3	3	-0.07	-29.8
08/20/1985	17:12:35	-80.7	65.9	3	-0.07	-29.8
08/20/1985	18:03:33	80.7	-125.8	46	-0.07	-29.8
08/20/1985	18:54:36	-80.6	41.8	52	-0.07	-29.8
08/20/1985	19:45:34	80.6	-149.9	95	-0.07	-29.8
10/15/1985	12:13:06	-80.8	139.2	93	-1.56	-32.3
10/15/1985	13:04:10	80.8	-52.8	77	-1.56	-32.3
10/15/1985	13:55:07	-80.7	115.1	45	-1.56	-32.3
10/15/1985	14:46:12	80.7	-77.3	28	-1.56	-32.3
10/15/1985	15:37:08	-80.7	91.0	4	-1.56	-32.3
10/15/1985	16:28:13	80.7	-101.4	20	-1.56	-32.3
10/15/1985	17:19:09	-80.6	66.9	52	-1.56	-32.3
10/15/1985	18:10:14	80.6	-125.5	69	-1.56	-32.3
12/10/1985	14:52:19	80.8	-79.2	90	-0.64	-32.5
12/10/1985	15:43:25	-80.7	88.6	68	-0.64	-32.5
12/10/1985	16:34:21	80.7	-103.7	42	-0.64	-32.5
12/10/1985	17:25:26	-80.7	64.5	20	-0.64	-32.5
12/10/1985	18:16:22	80.6	-127.8	7	-0.64	-32.5
12/10/1985	19:07:27	-80.6	40.3	29	-0.64	-32.5

12/10/1985	19:58:23	80.6	-151.9	55	-0.64	-32.5
12/10/1985	20:49:29	-80.5	15.8	77	-0.64	-32.5
02/04/1986	22:37:10	-80.8	-14.7	99	0.57	327.7
02/04/1986	23:28:15	80.7	153.7	63	0.57	327.7
02/05/1986	00:19:10	-80.7	-38.5	52	0.57	327.7
02/05/1986	01:10:16	80.6	129.6	15	0.57	327.7
02/05/1986	02:01:12	-80.6	-63.0	4	0.57	327.7
02/05/1986	02:52:17	80.6	105.4	33	0.57	327.7
02/05/1986	03:43:12	-80.5	-86.8	44	0.57	327.7
02/05/1986	04:34:19	80.5	80.9	81	0.57	327.7
02/05/1986	05:25:14	-80.5	-111.4	92	0.57	327.7
04/02/1986	12:18:41	-80.7	142.2	75	-0.00	-33.9
04/02/1986	13:09:37	80.7	-50.4	68	-0.00	-33.9
04/02/1986	14:00:42	-80.6	118.0	28	-0.00	-33.9
04/02/1986	14:51:38	80.6	-74.6	20	-0.00	-33.9
04/02/1986	15:42:44	-80.6	93.5	20	-0.00	-33.9
04/02/1986	16:33:39	80.5	-98.8	28	-0.00	-33.9
04/02/1986	17:24:44	-80.5	69.6	67	-0.00	-33.9
04/02/1986	18:15:40	80.5	-123.0	75	-0.00	-33.9
09/20/1986	04:17:30	80.6	86.3	86	-0.85	-37.7
09/20/1986	05:08:31	-80.6	-106.7	89	-0.85	-37.7
09/20/1986	05:59:31	80.6	62.1	39	-0.85	-37.7
09/20/1986	06:50:32	-80.6	-131.0	42	-0.85	-37.7
09/20/1986	07:41:32	80.5	37.9	8	-0.85	-37.7
09/20/1986	08:32:33	-80.5	-155.2	5	-0.85	-37.7
09/20/1986	09:23:33	80.4	13.6	55	-0.85	-37.7
09/20/1986	10:14:34	-80.4	-179.4	52	-0.85	-37.7
09/20/1986	11:56:34	-80.3	156.6	99	-0.85	-37.7
11/16/1986	10:06:18	-80.6	-179.0	69	0.42	-37.3
11/16/1986	10:57:20	80.6	-11.8	67	0.42	-37.3
11/16/1986	11:48:19	-80.5	156.8	22	0.42	-37.3
11/16/1986	12:39:21	80.5	-36.0	21	0.42	-37.3
11/16/1986	13:30:20	-80.4	132.5	24	0.42	-37.3
11/16/1986	14:21:22	80.4	-60.3	26	0.42	-37.3
11/16/1986	15:12:21	-80.3	108.2	71	0.42	-37.3
11/16/1986	16:03:23	80.3	-84.6	73	0.42	-37.3
11/16/1986	10:06:41	-80.6	-179.0	67	-0.00	-37.7
11/16/1986	10:57:43	80.6	-11.8	66	-0.00	-37.7
11/16/1986	11:48:42	-80.5	156.7	21	-0.00	-37.7

**Class I SNOs between NOAA-09 and NOAA-08**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	ARRAN
02/07/1985	06:11:21	-78.9	-110.3	65	0.05	280.5
02/07/1985	07:02:12	78.4	60.3	77	0.05	280.5
04/20/1985	12:47:51	78.9	-28.7	46	1.46	-77.3
04/20/1985	13:38:41	-78.4	141.5	89	1.46	-77.3
08/16/1985	00:02:41	78.7	165.0	42	0.92	-76.2
10/09/1985	03:55:31	79.1	104.3	64	-1.21	-77.5
10/09/1985	04:46:18	-78.8	-85.9	34	-1.21	-77.5
12/11/1985	10:25:11	-79.0	-171.1	12	-1.89	283.0

**Class I SNOs between NOAA-10 and NOAA-06**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	ARRAN
10/01/1986	14:47:18	-81.3	155.7	98	-0.29	15.4
10/01/1986	15:37:57	81.3	-35.9	62	-0.29	15.4
10/01/1986	16:28:30	-81.3	132.5	30	-0.29	15.4
10/01/1986	17:19:08	81.3	-58.8	7	-0.29	15.4
10/01/1986	18:09:42	-81.3	109.3	39	-0.29	15.4
10/01/1986	19:00:19	81.3	-81.6	76	-0.29	15.4
11/11/1986	04:00:37	81.3	137.7	65	0.70	17.4
11/11/1986	04:51:14	-81.3	-55.2	75	0.70	17.4
11/11/1986	05:41:48	81.3	114.9	4	0.70	17.4
11/11/1986	06:32:26	-81.3	-78.4	7	0.70	17.4

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
11/11/1986	07:23:01	81.3	91.3	73	0.70	17.4
11/11/1986	08:13:37	-81.3	-101.2	62	0.70	17.4

**Class I SNOs between NOAA-10 and NOAA-07**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
09/21/1986	10:00:32	-80.8	-146.9	42	-0.54	31.7
09/21/1986	10:51:20	80.6	17.3	70	-0.54	31.7
09/21/1986	10:51:33	80.9	21.7	94	0.02	32.3
09/21/1986	11:42:22	-80.7	-174.7	46	0.02	32.3
10/23/1986	20:15:20	-80.8	60.4	71	-1.39	30.0
10/23/1986	21:06:13	80.7	-135.5	55	-1.39	30.0
11/03/1986	16:13:59	-80.7	118.7	14	-0.77	30.2

**Class I SNOs between NOAA-10 and NOAA-09**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
09/21/1986	07:29:46	79.1	52.2	87	-1.96	67.1
09/21/1986	06:38:51	-79.4	-112.6	19	-1.82	67.2
09/21/1986	07:29:56	79.4	54.7	22	-0.27	68.8
09/21/1986	08:20:45	-79.0	-140.8	97	-0.27	68.8
09/30/1986	09:16:13	79.5	29.4	77	-0.26	68.7
09/30/1986	10:06:59	-79.2	-165.9	42	-0.26	68.7
09/30/1986	10:07:00	-79.2	-166.1	42	-0.26	68.7
10/27/1986	15:25:52	-79.4	115.9	13	-1.76	66.9
11/05/1986	17:12:05	-79.6	91.1	80	-1.39	67.1
11/05/1986	18:02:59	79.2	-104.9	51	-1.39	67.1
11/23/1986	21:35:18	79.6	-154.6	82	-0.55	67.7
11/23/1986	22:26:10	-79.2	9.7	46	-0.55	67.7
03/22/1987	04:11:52	-79.6	-73.1	46	1.00	67.5
03/22/1987	05:02:43	79.2	90.9	92	1.00	67.5
03/31/1987	06:48:41	79.5	67.0	14	0.45	66.8
04/09/1987	09:25:34	-79.5	-152.8	9	-0.63	65.5
04/18/1987	12:02:06	79.8	-9.3	96	0.02	66.1
04/18/1987	12:53:02	-79.4	154.8	34	0.02	66.1
05/15/1987	19:52:29	-79.7	52.3	45	-0.35	65.2
05/15/1987	20:43:16	79.3	-143.4	84	-0.35	65.2
05/24/1987	22:29:12	79.6	-167.3	30	0.74	66.2

05/24/1987	23:20:03	-79.2	-2.9	99	-0.71	64.6
06/21/1987	06:19:19	-79.6	-105.0	6	-1.14	63.6
07/09/1987	11:32:42	-79.6	176.7	2	0.01	64.5
08/05/1987	19:22:43	79.6	-120.2	7	0.03	64.0
08/24/1987	00:35:55	79.7	161.6	4	0.37	63.9
09/02/1987	03:12:36	-79.7	-57.0	25	-1.19	62.2
09/11/1987	05:49:08	79.7	83.9	23	-0.12	63.1
11/23/1987	02:41:31	79.8	131.6	21	0.72	62.3
11/23/1987	03:32:19	-79.5	-63.9	97	0.72	62.3
12/11/1987	07:54:19	79.9	54.4	59	-0.13	-299.0
12/11/1987	08:45:12	-79.6	-141.2	60	-0.13	-299.0
12/20/1987	10:30:46	-80.0	-163.8	90	-0.26	-299.3
12/20/1987	11:21:31	79.6	0.1	53	-0.26	-299.3
12/29/1987	13:57:59	-79.7	141.7	27	-0.62	-299.9
01/07/1988	17:24:58	-79.8	90.6	9	-1.17	-300.7
01/07/1988	16:34:15	79.8	-76.8	4	-1.62	-301.2
01/16/1988	19:10:40	-79.8	64.6	14	0.10	-299.6
02/04/1988	01:13:52	80.0	155.8	75	1.79	61.6
02/04/1988	02:04:42	-79.6	-40.5	70	1.79	61.6
02/04/1988	00:23:14	-80.0	-11.9	63	-0.21	59.5
02/04/1988	01:14:05	79.6	152.1	62	-0.21	59.5
02/13/1988	02:59:32	80.1	130.0	96	-0.77	58.7
02/13/1988	03:50:20	-79.7	-66.3	45	-0.77	58.7
02/22/1988	06:26:39	79.8	75.5	14	-0.70	58.6
03/02/1988	09:02:49	-79.9	-142.8	16	0.01	59.1
03/11/1988	11:39:07	80.0	-1.2	37	0.02	58.8
03/11/1988	12:29:52	-79.7	163.3	83	0.02	58.8
03/20/1988	14:15:15	-80.1	141.1	87	-0.05	58.5
03/20/1988	15:06:09	79.7	-55.5	69	-0.05	58.5
03/29/1988	18:32:57	79.8	-106.1	24	-0.06	58.2
04/07/1988	21:09:05	-80.0	36.5	38	0.02	58.1
04/16/1988	23:45:09	80.1	178.2	63	0.01	57.8
04/17/1988	00:36:02	-79.8	-17.4	55	0.01	57.8
05/14/1988	07:33:31	-80.1	-118.1	80	0.52	57.6
05/14/1988	08:24:15	79.8	46.2	49	0.52	57.6
05/14/1988	08:24:04	80.2	49.4	90	0.00	57.0
05/14/1988	09:14:59	-79.8	-146.7	53	0.00	57.0
06/01/1988	14:26:52	-80.1	138.1	53	0.08	56.6
06/01/1988	15:17:40	79.8	-57.5	65	0.08	56.6

06/10/1988	17:02:57	80.0	-82.5	15	1.00	57.2	10/23/1989	02:19:07	-78.6	-57.5	82	-1.05	-85.6
06/28/1988	23:05:15	-80.2	9.7	82	0.36	56.0	10/23/1989	03:09:59	78.1	112.8	46	-1.05	-85.6
06/28/1988	23:56:10	79.9	173.5	51	0.36	56.0	10/23/1989	03:10:00	78.1	112.6	46	-1.05	-85.6
07/26/1988	08:34:18	79.9	44.1	57	0.64	55.5	11/08/1989	19:02:24	78.4	-127.0	26	-0.07	-84.3
08/13/1988	12:55:01	-80.2	162.0	55	-0.54	53.9	11/08/1989	19:53:09	-77.9	43.0	97	-0.07	-84.3
09/09/1988	22:23:12	80.2	-160.2	44	-1.47	52.0	11/17/1989	02:58:14	-78.6	-67.0	69	0.00	-84.1
09/09/1988	23:14:07	-79.9	3.8	94	-1.47	52.0	11/17/1989	03:49:08	78.0	103.4	62	0.00	-84.1
10/07/1988	07:00:21	80.3	71.9	75	0.24	52.9	11/25/1989	10:54:00	78.7	-6.6	98	-0.43	-84.4
10/07/1988	07:51:13	-79.9	-125.0	88	0.24	52.9	11/25/1989	11:44:46	-78.2	163.5	22	-0.43	-84.4
10/16/1988	10:26:28	80.1	18.4	0	-1.05	51.3	12/03/1989	19:40:21	78.4	-136.0	8	0.67	276.8
11/12/1988	18:11:54	-80.3	83.9	58	0.43	51.9	12/28/1989	20:16:58	78.4	-145.1	3	1.82	278.5
11/12/1988	19:02:49	80.0	-112.6	89	0.43	51.9	01/06/1990	04:11:59	-78.6	-84.9	52	0.07	276.9
12/01/1988	00:12:37	80.3	173.0	33	0.85	-308.4	01/06/1990	05:02:44	78.1	85.5	86	0.07	276.9
12/01/1988	01:03:23	-80.0	-22.2	78	0.85	-308.4	01/14/1990	12:06:46	78.7	-24.3	79	0.61	277.6
12/19/1988	06:12:57	-80.3	-96.3	48	-0.85	-310.7	01/14/1990	12:57:40	-78.2	145.9	41	0.61	277.6
12/28/1988	08:47:30	80.4	46.1	81	0.02	-310.0	02/16/1990	21:26:53	78.5	-162.6	13	-0.03	277.6
12/28/1988	09:38:23	-80.2	-149.6	34	0.02	-310.0	02/25/1990	05:21:16	-78.7	-102.5	69	-0.23	-82.4
							02/25/1990	06:12:08	78.2	67.6	57	-0.23	-82.4
							03/05/1990	14:06:21	-78.5	127.9	7	-0.17	-82.2
							03/22/1990	06:45:29	78.4	58.9	32	-0.22	-81.8
							03/30/1990	14:39:22	-78.7	118.8	33	-0.02	-81.5
03/03/1989	13:23:19	78.3	-43.9	85	0.88	-87.1	04/07/1990	22:33:12	78.8	179.5	73	0.76	-80.5
03/03/1989	14:14:05	-77.8	126.1	34	0.88	-87.1	04/07/1990	23:23:59	-78.4	-10.5	42	0.76	-80.5
03/11/1989	22:13:40	78.1	-175.1	28	1.66	-86.2	04/07/1990	23:24:00	-78.4	-10.7	43	0.76	-80.5
03/11/1989	23:04:27	-77.6	-5.4	92	1.66	-86.2	04/16/1990	07:17:44	78.6	50.0	8	-1.05	-82.1
03/20/1989	06:12:55	-78.3	-116.1	82	0.05	-87.7	04/24/1990	15:11:21	-78.9	109.4	95	0.67	-80.3
03/20/1989	07:03:50	77.8	53.7	43	0.05	-87.7	04/24/1990	16:02:08	78.4	-79.8	51	0.67	-80.3
03/28/1989	15:02:51	-78.0	112.8	12	-0.07	-87.6	05/02/1990	23:55:34	-78.6	-19.7	13	-1.20	-81.9
04/30/1989	23:48:44	78.4	159.6	93	-0.38	-87.6	05/28/1990	00:26:07	-78.8	-28.2	55	0.47	-79.7
05/01/1989	00:39:39	-77.9	-30.4	24	-0.38	-87.6	05/28/1990	01:16:52	78.4	142.1	79	0.47	-79.7
07/31/1989	17:58:49	78.4	-112.3	74	-0.04	-85.9	06/22/1990	00:55:50	-78.9	-36.0	67	-0.00	-79.5
07/31/1989	18:49:38	-78.0	57.6	46	-0.04	-85.9	06/22/1990	01:46:39	78.5	134.3	57	-0.00	-79.5
08/09/1989	01:56:15	-78.5	-52.0	89	0.26	-85.5	06/30/1990	09:39:28	-78.6	-164.7	18	-0.29	-79.6
08/09/1989	02:47:05	78.0	118.3	42	0.26	-85.5	07/08/1990	18:23:04	-78.3	66.2	99	1.93	-77.3
08/17/1989	09:53:35	78.5	8.7	90	-0.09	-85.7	07/08/1990	17:32:19	78.8	-104.1	30	-1.27	-80.4
08/17/1989	10:44:28	-78.1	178.5	28	-0.09	-85.7	07/25/1990	10:08:28	-78.7	-171.9	20	-0.03	-78.9
08/25/1989	18:41:36	78.0	-120.6	32	-0.03	-85.5	08/02/1990	18:01:10	78.8	-110.6	8	-0.07	-78.6
09/03/1989	01:47:53	78.6	129.8	99	0.20	-85.2	08/11/1990	01:53:42	-79.0	-50.0	53	0.06	-78.3
09/03/1989	02:38:48	-78.1	-60.2	19	0.20	-85.2	08/11/1990	02:44:33	78.4	120.9	95	0.06	-78.3

**Class I SNOs between NOAA-11 and NOAA-10**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
03/03/1989	13:23:19	78.3	-43.9	85	0.88	-87.1
03/03/1989	14:14:05	-77.8	126.1	34	0.88	-87.1
03/11/1989	22:13:40	78.1	-175.1	28	1.66	-86.2
03/11/1989	23:04:27	-77.6	-5.4	92	1.66	-86.2
03/20/1989	06:12:55	-78.3	-116.1	82	0.05	-87.7
03/20/1989	07:03:50	77.8	53.7	43	0.05	-87.7
03/28/1989	15:02:51	-78.0	112.8	12	-0.07	-87.6
04/30/1989	23:48:44	78.4	159.6	93	-0.38	-87.6
05/01/1989	00:39:39	-77.9	-30.4	24	-0.38	-87.6
07/31/1989	17:58:49	78.4	-112.3	74	-0.04	-85.9
07/31/1989	18:49:38	-78.0	57.6	46	-0.04	-85.9
08/09/1989	01:56:15	-78.5	-52.0	89	0.26	-85.5
08/09/1989	02:47:05	78.0	118.3	42	0.26	-85.5
08/17/1989	09:53:35	78.5	8.7	90	-0.09	-85.7
08/17/1989	10:44:28	-78.1	178.5	28	-0.09	-85.7
08/25/1989	18:41:36	78.0	-120.6	32	-0.03	-85.5
09/03/1989	01:47:53	78.6	129.8	99	0.20	-85.2
09/03/1989	02:38:48	-78.1	-60.2	19	0.20	-85.2

08/19/1990	09:46:15	79.0	11.6	69	0.05	-78.2	05/30/1991	09:42:34	-79.2	-164.1	38	0.34	-69.7
08/19/1990	10:37:04	-78.7	-178.6	43	0.05	-78.2	06/16/1991	03:01:03	-79.2	-63.6	49	0.97	-68.6
08/27/1990	18:29:30	78.7	-116.9	32	-0.03	-78.1	06/24/1991	10:49:19	79.7	-4.3	94	0.01	-69.2
09/21/1990	18:06:18	-79.2	66.0	91	1.24	-76.2	06/24/1991	11:40:08	-79.2	167.1	64	0.01	-69.2
09/21/1990	18:57:02	78.7	-123.3	50	1.24	-76.2	07/02/1991	19:28:21	79.6	-133.6	85	-0.03	-69.1
09/30/1990	02:49:08	-78.8	-62.2	4	0.97	-76.2	07/02/1991	20:19:09	-79.2	37.7	76	-0.03	-69.1
11/02/1990	11:58:03	-78.8	161.4	39	1.25	-75.1	07/11/1991	04:07:19	79.6	96.9	73	-0.02	-68.7
11/19/1990	04:32:05	78.9	92.3	16	1.18	-74.7	07/11/1991	04:58:05	-79.2	-91.7	87	-0.02	-68.7
11/27/1990	12:23:27	-79.2	152.3	59	-0.45	-76.1	07/19/1991	12:46:10	79.6	-32.3	52	0.04	-68.5
11/27/1990	13:14:20	78.7	-36.6	82	-0.45	-76.1	07/27/1991	21:24:59	79.5	-161.3	27	-0.08	-68.2
12/05/1990	21:05:41	-79.1	23.2	15	1.81	286.4	08/05/1991	06:03:42	79.5	69.8	3	-1.12	-68.9
12/14/1990	04:57:03	79.3	83.6	83	-0.35	284.6	08/21/1991	23:20:53	79.3	172.3	68	1.81	-65.6
12/14/1990	05:47:49	-78.9	-106.2	31	-0.35	284.6	08/30/1991	07:08:31	-79.7	-128.4	77	-0.07	-67.0
12/22/1990	13:39:03	79.1	-45.3	31	0.96	286.0	08/30/1991	07:59:19	79.3	43.3	98	-0.07	-67.0
12/22/1990	14:29:52	-78.8	124.4	80	0.96	286.0	09/07/1991	15:46:51	-79.7	102.8	54	0.05	-66.7
01/08/1991	07:02:53	78.9	55.7	51	1.66	287.2	09/16/1991	00:25:08	-79.6	-26.2	27	-0.06	-66.5
01/24/1991	23:35:44	-79.2	-14.5	29	-0.00	286.1	09/24/1991	09:03:18	-79.6	-155.0	6	0.13	-66.1
02/02/1991	08:17:23	-79.1	-144.1	5	-0.29	286.1	10/02/1991	17:41:21	-79.5	76.0	17	0.04	-65.9
02/10/1991	16:58:51	-79.0	86.4	33	-0.09	286.5	10/11/1991	02:19:16	-79.5	-53.1	30	-0.37	-66.0
02/19/1991	00:49:25	79.4	145.4	92	-0.01	-73.2	10/19/1991	10:57:05	-79.5	177.7	38	-0.09	-65.4
02/19/1991	01:40:15	-79.0	-43.6	58	-0.01	-73.2	10/27/1991	19:34:47	-79.6	48.2	39	-0.02	-65.0
03/07/1991	18:11:43	79.4	-114.3	68	0.00	-72.6	11/05/1991	04:12:17	-79.6	-81.3	35	0.05	-64.7
03/07/1991	19:02:29	-78.9	56.7	82	0.00	-72.6	11/13/1991	12:49:38	-79.6	149.1	25	0.21	-64.1
03/16/1991	02:52:36	79.4	115.5	63	-0.36	-72.8	11/21/1991	21:26:51	-79.7	19.6	13	0.03	-64.2
03/16/1991	03:43:21	-78.9	-73.6	85	-0.36	-72.8	11/30/1991	06:03:59	-79.7	-110.2	6	-0.08	-63.8
03/24/1991	11:33:15	79.4	-14.5	60	0.48	-71.7	12/08/1991	14:41:03	-79.8	120.0	28	-0.14	296.4
03/24/1991	12:23:59	-79.0	156.3	80	0.48	-71.7	12/16/1991	23:18:03	-79.9	-9.8	50	0.03	296.8
03/24/1991	12:24:00	-79.0	156.0	81	0.48	-71.7	12/25/1991	07:54:56	-79.9	-139.7	77	-0.09	297.0
04/01/1991	20:13:38	79.4	-144.4	55	0.28	-71.6	12/25/1991	08:45:45	79.5	32.2	99	-0.09	297.0
04/01/1991	21:04:22	-79.0	26.1	75	0.28	-71.6							
04/10/1991	04:53:53	79.4	85.3	55	1.33	-70.3							
04/10/1991	05:44:37	-79.0	-104.2	66	1.33	-70.3							
04/26/1991	22:13:39	79.5	-174.7	62	0.63	-70.5							
04/26/1991	23:04:26	-79.1	-4.6	47	0.63	-70.5							
05/05/1991	06:53:19	79.5	55.2	70	-0.41	-71.2							
05/05/1991	07:44:08	-79.2	-134.8	38	-0.41	-71.2							
05/13/1991	15:32:53	79.5	-74.7	71	1.02	-69.7							
05/13/1991	16:23:44	-79.2	95.4	41	1.02	-69.7							
05/30/1991	08:51:42	79.6	25.3	91	0.34	-69.7							

**Class I SNOs between NOAA-12 and NOAA-10**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
08/20/1991	10:12:53	81.3	54.1	51	1.82	7.8
08/20/1991	11:03:29	-81.2	-134.8	28	1.82	7.8
08/20/1991	11:53:59	81.2	34.8	25	1.82	7.8
09/26/1991	09:54:32	-81.3	-120.2	81	0.06	6.6
09/26/1991	10:45:11	81.2	48.9	8	0.06	6.6
09/26/1991	11:35:50	-81.3	-144.3	6	0.06	6.6





05/06/1992	16:05:47	79.5	-73.1	18	0.02	67.5	01/07/1993	20:29:33	80.0	-135.1	60	-0.04	-299.9
05/06/1992	16:56:37	-79.2	92.4	51	0.02	67.5	01/07/1993	21:20:22	-79.8	30.6	5	-0.04	-299.9
05/17/1992	09:37:15	-79.5	-155.7	28	-0.05	67.1	01/18/1993	13:08:41	80.0	-24.7	58	0.03	-300.2
05/17/1992	10:28:06	79.1	8.6	98	0.15	67.3	01/18/1993	13:59:29	-79.8	140.5	25	0.03	-300.2
05/28/1992	02:17:49	-79.7	-44.1	93	0.28	67.1	01/29/1993	05:47:45	80.0	85.7	65	-0.06	59.3
05/28/1992	03:08:39	79.4	120.9	8	0.28	67.1	01/29/1993	06:38:33	-79.7	-109.8	44	-0.06	59.3
06/07/1992	20:39:54	-79.4	37.5	29	0.29	66.8	02/08/1993	22:26:46	80.0	-163.8	72	0.16	59.2
06/07/1992	19:49:08	79.7	-127.0	83	-0.28	66.3	02/08/1993	23:17:33	-79.7	0.4	64	0.16	59.2
06/18/1992	13:20:23	-79.5	148.1	8	-0.27	66.0	02/19/1993	15:05:43	80.1	-53.3	73	-0.12	58.6
06/18/1992	14:11:13	79.3	-46.1	72	-0.27	66.0	02/19/1993	15:56:31	-79.6	110.2	82	-0.12	58.6
06/29/1992	06:00:45	-79.6	-100.5	49	0.02	66.0	03/02/1993	07:44:36	80.1	57.0	67	0.09	58.4
06/29/1992	06:51:34	79.5	65.3	16	0.02	66.0	03/02/1993	08:35:25	-79.6	-139.7	96	0.09	58.4
07/09/1992	23:31:52	79.6	176.4	28	0.02	65.7	03/13/1993	00:23:25	80.0	167.1	58	-0.05	57.9
07/20/1992	16:12:07	79.7	-72.9	60	-0.07	65.2	03/13/1993	01:14:15	-79.6	-29.4	98	-0.05	57.9
07/20/1992	17:02:57	-79.4	91.8	58	-0.07	65.2	03/23/1993	17:52:59	-79.7	81.1	99	-0.11	57.5
07/31/1992	08:52:18	79.8	37.9	85	-0.06	65.0	03/23/1993	17:53:00	-79.6	80.8	99	-0.11	57.5
07/31/1992	09:43:09	-79.5	-157.1	5	-0.06	65.0	03/23/1993	17:02:08	80.0	-82.9	37	0.09	57.7
08/11/1992	02:23:17	-79.7	-45.8	36	-0.07	64.6	04/03/1993	09:40:48	80.0	26.8	9	-0.07	57.0
08/21/1992	19:54:11	79.3	-131.6	96	1.94	66.5	04/14/1993	02:19:23	79.9	136.4	22	-0.05	56.7
08/21/1992	19:03:23	-79.8	64.8	67	0.15	64.6	04/24/1993	18:57:54	79.9	-113.6	51	0.01	56.3
09/01/1992	11:43:24	-79.9	175.8	90	-0.04	64.2	05/05/1993	10:45:34	-80.2	-166.9	92	-0.07	55.8
09/01/1992	12:34:14	79.4	-21.1	75	-0.04	64.2	05/05/1993	11:36:23	79.8	-4.0	80	-0.07	55.8
09/12/1992	04:23:27	-79.8	-74.9	64	-0.12	63.8	05/16/1993	03:23:58	-80.1	-57.4	57	-0.20	55.3
09/12/1992	05:14:13	79.5	89.9	43	0.06	63.8	05/26/1993	20:02:18	-80.1	52.1	12	0.37	55.6
09/22/1992	21:54:09	79.6	-159.2	14	0.03	63.6	06/06/1993	11:49:48	80.2	-2.9	74	-0.12	54.7
10/03/1992	14:34:02	79.7	-48.3	22	0.10	63.4	06/06/1993	12:40:35	-80.0	161.5	43	-0.12	54.7
10/14/1992	07:13:50	79.8	62.6	52	0.01	62.9	06/17/1993	04:28:02	80.2	106.7	37	-0.05	54.3
10/14/1992	08:04:39	-79.4	-133.8	98	0.01	62.9	06/27/1993	20:15:24	-80.2	50.6	71	-0.06	53.9
10/24/1992	23:53:34	79.9	173.4	74	0.03	62.6	06/27/1993	21:06:13	80.1	-143.7	5	-0.06	53.9
11/04/1992	16:33:15	79.9	-76.1	92	-0.11	62.2	07/08/1993	12:53:32	-80.1	159.7	14	-0.05	53.6
11/04/1992	17:24:05	-79.5	87.4	65	-0.11	62.2	07/08/1993	13:44:20	80.0	-34.5	59	-0.05	53.6
11/26/1992	01:52:21	80.0	144.3	91	-0.12	61.4	07/19/1993	05:31:38	-80.0	-91.0	48	0.02	53.2
11/26/1992	02:43:11	-79.7	-50.9	24	-0.12	61.4	07/29/1993	21:18:51	80.2	-145.9	31	-0.05	52.7
12/06/1992	18:31:46	79.9	-105.7	80	-0.05	-298.9	08/09/1993	13:06:04	-80.3	158.9	76	0.09	52.5
12/06/1992	19:22:37	-79.7	59.4	8	-0.05	-298.9	08/09/1993	13:56:51	80.0	-37.3	53	0.09	52.5
12/17/1992	11:11:06	80.0	4.5	68	0.00	-299.2	08/20/1993	04:53:12	80.4	102.5	97	-0.05	52.0
12/17/1992	12:01:57	-79.8	170.0	2	0.00	-299.2	08/20/1993	05:44:03	-80.2	-92.3	12	-0.05	52.0
12/28/1992	03:50:22	80.0	114.8	65	0.09	-299.4	08/30/1993	21:31:08	80.2	-149.0	13	-0.06	51.5
12/28/1992	04:41:12	-79.8	-79.5	6	0.09	-299.4	08/30/1993	22:21:58	-80.0	16.7	56	-0.06	51.5

09/10/1993	14:09:02	80.0	-40.3	67	0.02	51.2	07/27/1994	03:09:25	-80.7	-49.4	57	-0.05	37.1
09/21/1993	05:05:16	80.4	100.1	96	-0.05	50.6	07/27/1994	04:00:12	80.6	115.8	32	-0.05	37.1
09/21/1993	05:56:04	-80.3	-94.7	19	-0.05	50.6	08/06/1994	18:55:16	80.7	-107.1	5	-0.05	36.6
10/01/1993	21:43:07	80.3	-151.4	24	0.17	50.5	08/17/1994	09:50:17	80.7	30.1	34	0.02	36.1
10/01/1993	22:33:54	-80.0	13.4	75	0.17	50.5	08/17/1994	10:41:10	-80.5	-166.2	94	0.02	36.1
10/12/1993	13:30:03	-80.4	152.9	60	-0.05	49.8	08/28/1994	00:45:18	80.8	167.0	61	-0.06	35.5
10/12/1993	14:20:54	80.1	-42.6	55	-0.05	49.8	08/28/1994	01:36:10	-80.6	-28.5	46	-0.06	35.5
11/13/1993	13:41:35	-80.3	148.9	3	0.01	48.5	09/07/1994	15:40:18	80.8	-56.3	84	-0.05	35.1
11/13/1993	14:32:23	80.1	-45.5	74	0.01	48.5	09/07/1994	16:31:09	-80.7	108.7	5	-0.05	35.1
11/24/1993	05:28:23	80.4	93.8	57	0.07	47.9	09/18/1994	07:26:05	-80.7	-113.9	29	0.03	34.7
11/24/1993	06:19:14	-80.1	-102.9	97	-0.07	47.9	09/28/1994	22:21:00	-80.8	23.1	53	0.03	34.2
12/04/1993	21:15:12	-80.4	36.9	45	0.02	-312.3	10/09/1994	13:15:54	-80.8	159.6	65	0.09	33.7
12/04/1993	22:05:58	80.2	-158.5	65	0.02	-312.3	10/09/1994	14:06:45	80.5	-37.1	89	0.09	33.7
01/05/1994	20:35:16	80.4	-133.3	36	-0.84	-314.6	10/20/1994	04:10:47	-80.8	-64.1	68	0.02	33.1
01/05/1994	21:26:06	-80.3	32.2	36	-0.84	-314.6	10/20/1994	05:01:38	80.6	99.9	65	0.02	33.1
01/16/1994	12:21:53	-80.6	171.6	82	0.10	-314.0	10/30/1994	19:05:38	-80.8	72.1	61	0.03	32.6
01/16/1994	13:12:42	80.2	-25.5	90	0.10	-314.0	10/30/1994	19:56:30	80.6	-123.7	51	0.03	32.6
01/27/1994	04:08:29	80.5	113.7	33	-0.06	45.3	11/10/1994	10:00:28	-80.8	-151.9	50	-0.05	32.0
01/27/1994	04:59:16	-80.3	-81.1	52	-0.06	45.3	11/10/1994	10:51:18	80.7	13.1	46	-0.05	32.0
02/17/1994	12:32:18	-80.2	164.7	100	-0.84	43.5	11/21/1994	00:55:16	-80.8	-15.8	36	-0.06	31.4
02/17/1994	11:41:32	80.5	0.7	32	0.07	44.4	11/21/1994	01:46:05	80.7	149.1	53	-0.06	31.4
02/28/1994	03:27:57	-80.5	-56.6	2	0.09	44.1	12/01/1994	15:50:03	-80.8	120.1	20	-0.05	30.9
02/28/1994	04:18:48	80.3	108.4	94	0.09	44.1	12/01/1994	16:40:50	80.6	-75.1	74	-0.05	30.9
03/10/1994	18:23:35	-80.6	81.9	93	0.02	43.6	12/12/1994	06:44:48	-80.8	-104.1	0	-0.05	-329.6
03/10/1994	19:14:24	80.5	-112.8	13	0.02	43.6	12/22/1994	21:39:31	-80.7	31.6	19	0.03	-330.0
04/11/1994	17:42:35	80.6	-88.9	37	0.09	42.2	01/02/1995	11:43:20	80.9	2.6	58	-0.05	-330.6
04/11/1994	18:33:28	-80.3	74.8	93	0.09	42.2	01/02/1995	12:34:12	-80.7	167.2	49	-0.05	-330.6
04/22/1994	09:28:55	-80.5	-146.4	4	-0.92	40.5	01/13/1995	02:38:00	80.8	137.7	5	-0.05	28.8
05/24/1994	07:05:50	80.7	71.6	79	0.00	40.0	01/13/1995	03:28:51	-80.6	-57.4	88	-0.05	28.8
05/24/1994	07:56:38	-80.6	-123.1	0	0.00	40.0	01/23/1995	17:32:39	80.7	-87.2	48	0.09	28.4
06/03/1994	22:51:54	-80.7	14.8	57	0.01	39.6	02/03/1995	07:36:28	-80.9	-115.5	63	-0.05	27.7
06/03/1994	23:42:45	80.4	178.1	96	0.01	39.6	02/13/1995	22:31:03	-80.8	19.1	6	0.03	27.3
06/14/1994	14:38:01	80.5	-43.9	20	0.02	39.2	02/24/1995	12:34:52	80.9	-10.3	49	-0.05	26.7
06/25/1994	05:33:14	80.7	94.1	50	0.02	38.7	02/24/1995	13:25:37	-80.7	153.7	78	-0.05	26.7
06/25/1994	06:23:59	-80.4	-101.8	88	0.02	38.7	03/07/1995	03:29:25	80.8	124.6	10	0.08	26.2
06/25/1994	06:24:00	-80.4	-102.1	88	0.02	38.7	03/17/1995	17:33:07	-80.9	94.2	24	-0.05	25.6
07/05/1994	21:19:10	-80.5	35.6	41	0.03	38.2	03/17/1995	18:23:57	80.7	-100.9	76	-0.05	25.6
07/16/1994	12:14:18	-80.6	173.1	7	0.03	37.7	03/28/1995	08:27:38	-80.8	-131.2	54	-0.05	25.1
07/16/1994	13:05:07	80.5	-21.8	78	0.03	37.7	04/07/1995	22:31:19	80.9	-160.4	27	-0.04	24.5

**Class I SNOs between NOAA-14 and NOAA-11**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
04/18/1995	12:35:01	-80.9	169.2	45	-0.05	23.9
04/18/1995	13:25:45	80.7	-26.2	70	-0.05	23.9
04/29/1995	02:38:36	81.0	139.0	85	-0.05	23.4
04/29/1995	03:29:27	-80.8	-56.5	42	-0.05	23.4
05/09/1995	17:33:00	80.8	-87.5	30	0.03	23.0
05/20/1995	07:36:39	-80.9	-117.6	13	0.02	22.4
05/30/1995	21:40:09	80.8	-148.9	17	0.03	21.9
06/10/1995	11:43:41	-80.9	-179.5	12	-0.05	21.2
06/21/1995	01:47:12	80.8	148.7	30	0.03	20.7
07/01/1995	14:59:53	81.0	-47.0	79	0.03	20.2
07/01/1995	15:50:37	-80.8	117.2	52	0.03	20.2
07/12/1995	05:03:16	-80.9	-79.2	32	0.02	19.6
07/12/1995	05:54:08	80.7	85.0	82	0.02	19.6
07/22/1995	19:06:43	80.9	-110.8	5	-0.04	19.0
08/02/1995	08:19:19	80.9	52.2	76	0.02	18.5
08/02/1995	09:10:06	-80.7	-144.1	85	-0.05	18.4
08/12/1995	22:22:41	-80.8	19.0	24	-0.06	17.8
08/23/1995	11:35:16	-80.9	-178.1	39	0.02	17.3
08/23/1995	12:25:59	80.7	-13.3	81	0.02	17.3
09/03/1995	00:47:48	-80.9	-15.1	93	0.02	16.8
09/03/1995	01:38:31	80.7	149.0	43	0.02	16.8
09/13/1995	14:51:02	80.8	-48.7	9	0.03	16.3
09/24/1995	04:03:33	80.8	113.3	21	0.01	15.6
09/24/1995	04:54:23	-80.6	-81.7	82	0.01	15.6
10/04/1995	18:06:50	-80.7	80.6	52	-0.04	15.1
10/04/1995	17:16:02	80.8	-84.4	49	0.02	15.1
10/15/1995	06:28:30	80.9	77.7	76	0.09	14.6
10/15/1995	07:19:16	-80.7	-117.5	32	0.09	14.6
10/25/1995	19:40:57	80.9	-120.4	99	-0.04	14.0
10/25/1995	20:31:40	-80.7	44.5	20	-0.04	14.0
11/15/1995	22:56:27	-80.7	7.3	21	-0.00	12.6
11/26/1995	12:08:51	-80.6	167.9	28	0.01	12.2
12/07/1995	01:21:12	-80.5	-30.9	41	0.08	11.6
12/17/1995	13:42:45	80.7	-34.9	97	-0.05	-349.0
12/17/1995	14:33:33	-80.5	129.7	55	-0.05	-349.0
12/28/1995	02:55:03	80.5	125.4	69	0.02	10.6
12/28/1995	03:45:51	-80.4	-69.2	72	0.02	10.6
01/31/1995	05:42:24	80.0	57.0	88	0.07	304.2
01/31/1995	06:33:22	-80.0	-135.2	64	0.07	304.2
01/31/1995	07:24:26	80.0	32.3	49	0.07	304.2
01/31/1995	08:15:23	-79.9	-159.7	25	0.07	304.2
01/31/1995	09:06:27	79.9	7.8	10	0.07	304.2
01/31/1995	09:57:24	-79.8	175.9	14	0.07	304.2
01/31/1995	10:48:28	79.8	-16.6	29	0.07	304.2
01/31/1995	11:39:26	-79.7	151.1	53	0.07	304.2
01/31/1995	12:30:29	79.7	-41.1	67	0.07	304.2
01/31/1995	13:21:27	-79.6	126.6	92	0.07	304.2
04/05/1995	17:51:44	80.0	-124.2	99	0.07	-58.1
04/05/1995	18:42:48	-79.9	43.2	92	0.07	-58.1
04/05/1995	19:33:45	79.9	-148.7	60	0.07	-58.1
04/05/1995	20:24:49	-79.8	18.8	54	0.07	-58.1
04/05/1995	21:15:46	79.8	-173.2	22	0.07	-58.1
04/05/1995	22:06:51	-79.8	-6.0	15	0.07	-58.1
04/05/1995	22:57:48	79.7	162.0	17	0.07	-58.1
04/05/1995	23:48:52	-79.7	-30.5	23	0.07	-58.1
04/06/1995	00:39:49	79.6	137.5	55	0.07	-58.1
04/06/1995	01:30:53	-79.6	-55.0	61	0.07	-58.1
04/06/1995	02:21:50	79.5	113.0	93	0.07	-58.1
04/06/1995	03:12:54	-79.4	-79.6	99	0.07	-58.1
06/09/1995	13:39:26	-79.8	120.8	79	-0.07	-60.5
06/09/1995	14:30:30	79.8	-71.6	64	-0.07	-60.5
06/09/1995	15:21:27	-79.7	96.3	41	-0.07	-60.5
06/09/1995	16:12:31	79.7	-96.1	26	-0.07	-60.5
06/09/1995	17:03:29	-79.6	71.5	5	-0.07	-60.5
06/09/1995	17:54:32	79.6	-120.7	12	-0.07	-60.5
06/09/1995	18:45:30	-79.5	47.0	34	-0.07	-60.5
06/09/1995	19:36:33	79.5	-145.2	49	-0.07	-60.5
06/09/1995	20:27:31	-79.4	22.4	72	-0.07	-60.5
06/09/1995	21:18:35	79.4	-170.1	87	-0.07	-60.5
08/13/1995	12:50:31	79.7	-45.7	88	-0.07	-62.8
08/13/1995	13:41:36	-79.7	121.5	80	-0.07	-62.8
08/13/1995	14:32:32	79.6	-70.3	50	-0.07	-62.8
08/13/1995	15:23:37	-79.6	97.0	43	-0.07	-62.8
08/13/1995	16:14:33	79.5	-94.8	13	-0.07	-62.8

08/13/1995	17:05:38	-79.5	72.4	7	-0.07	-62.8	02/02/1995	22:20:36	78.7	178.9	68	0.04	276.2
08/13/1995	17:56:34	79.4	-119.4	24	-0.07	-62.8	02/02/1995	23:11:25	-78.3	-11.5	25	0.04	276.2
08/13/1995	18:47:39	-79.4	47.8	31	-0.07	-62.8	02/12/1995	00:57:25	-78.7	-40.5	78	0.05	276.4
08/13/1995	19:38:35	79.3	-144.0	62	-0.07	-62.8	02/12/1995	01:48:17	78.2	129.9	54	0.05	276.4
08/13/1995	20:29:40	-79.3	23.2	68	-0.07	-62.8	02/21/1995	03:34:17	78.6	100.8	57	-0.02	276.4
08/13/1995	21:20:36	79.2	-168.6	99	-0.07	-62.8	02/21/1995	04:25:04	-78.2	-89.4	53	-0.02	276.4
10/17/1995	17:58:05	79.6	-121.2	98	-0.00	-64.9	03/02/1995	06:11:02	-78.6	-118.3	49	0.05	-83.4
10/17/1995	18:49:03	-79.6	46.3	77	-0.00	-64.9	03/02/1995	07:01:56	78.2	51.6	65	0.05	-83.4
10/17/1995	19:40:07	79.5	-146.1	61	-0.00	-64.9	03/11/1995	08:47:52	78.6	22.7	44	-0.02	-83.3
10/17/1995	20:31:04	-79.5	21.7	41	-0.00	-64.9	03/11/1995	09:38:39	-78.1	-167.1	83	-0.02	-83.3
10/17/1995	21:22:08	79.4	-170.7	25	-0.00	-64.9	03/20/1995	11:24:36	-78.5	163.9	22	0.05	-83.1
10/17/1995	22:13:05	-79.4	-2.9	4	-0.00	-64.9	03/20/1995	12:15:28	78.1	-26.5	81	0.05	-83.1
10/17/1995	23:04:09	79.3	164.7	12	-0.00	-64.9	03/29/1995	14:01:22	78.6	-55.4	26	-0.03	-83.0
10/17/1995	23:55:06	-79.3	-27.5	33	-0.00	-64.9	04/07/1995	16:38:06	-78.5	85.9	2	-0.02	-82.8
10/18/1995	00:46:10	79.2	140.1	49	-0.00	-64.9	04/16/1995	19:14:46	78.5	-133.2	4	-0.03	-82.7
10/18/1995	01:37:07	-79.1	-52.1	69	-0.00	-64.9	04/25/1995	21:00:36	78.9	-162.0	95	-0.23	-82.7
10/18/1995	02:28:11	79.1	115.5	86	-0.00	-64.9	04/25/1995	21:51:30	-78.4	8.0	17	-0.23	-82.7
12/22/1995	07:34:49	79.5	36.4	84	-0.07	292.8	05/04/1995	23:37:19	-78.8	-20.8	87	-0.02	-82.4
12/22/1995	08:25:54	-79.5	-156.3	77	-0.07	292.8	05/05/1995	00:28:06	78.4	149.3	45	-0.02	-82.4
12/22/1995	09:16:50	79.4	11.8	48	-0.07	292.8	05/14/1995	02:13:54	78.7	120.7	49	-0.09	-82.3
12/22/1995	10:07:55	-79.3	179.1	41	-0.07	292.8	05/14/1995	03:04:48	-78.4	-69.8	49	-0.09	-82.3
12/22/1995	10:58:51	79.2	-12.9	12	-0.07	292.8	05/23/1995	04:50:33	-78.7	-98.2	44	0.05	-82.0
12/22/1995	11:49:56	-79.2	154.4	5	-0.07	292.8	05/23/1995	05:41:21	78.2	72.3	98	0.05	-82.0
12/22/1995	12:40:52	79.1	-37.5	24	-0.07	292.8	06/01/1995	07:27:07	78.5	43.7	8	0.05	-81.8
12/22/1995	13:31:57	-79.1	129.8	31	-0.07	292.8	06/10/1995	09:12:51	78.9	15.2	78	0.06	-81.6
12/22/1995	14:22:53	79.0	-62.2	60	-0.07	292.8	06/10/1995	10:03:40	-78.5	-175.1	21	0.06	-81.6
12/22/1995	15:13:58	-79.0	105.1	67	-0.07	292.8	06/19/1995	11:49:21	-78.8	156.7	56	0.06	-81.5
12/22/1995	16:04:54	78.9	-86.9	96	-0.07	292.8	06/19/1995	12:40:14	78.3	-33.0	75	0.06	-81.5
01/06/1995	15:20:46	78.3	-73.8	27	-0.03	275.8	06/28/1995	14:25:55	78.6	-61.2	5	0.05	-81.3
01/06/1995	14:30:01	-78.7	116.1	92	0.33	276.1	07/07/1995	16:11:35	78.9	-89.6	79	0.05	-81.2
01/06/1995	15:20:53	78.0	-72.3	97	-0.51	275.3	07/07/1995	17:02:21	-78.4	80.7	44	0.05	-81.2
01/15/1995	17:06:50	78.7	-102.9	82	0.05	276.0	07/16/1995	18:48:00	-78.7	52.6	20	-0.02	-81.1
01/15/1995	17:57:42	-78.3	66.7	9	0.05	276.0	07/16/1995	19:38:53	78.3	-137.5	89	-0.02	-81.1
01/24/1995	20:34:34	78.2	-152.0	43	-0.02	276.0	07/25/1995	20:33:37	-78.9	24.9	80	-0.03	-81.0
01/24/1995	19:43:44	-78.7	37.5	99	-0.01	276.1	07/25/1995	21:24:29	78.5	-165.3	27	-0.03	-81.0
							08/03/1995	23:10:04	78.8	166.7	33	0.04	-80.7
							08/04/1995	00:00:54	-78.3	-22.9	97	-0.01	-80.7
							08/13/1995	00:53:37	79.0	139.1	86	0.06	-80.5
							08/13/1995	01:46:29	-78.5	-50.6	39	0.06	-80.5

**Class I SNOs between NOAA-14 and NOAA-12**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
01/06/1995	15:20:46	78.3	-73.8	27	-0.03	275.8
01/06/1995	14:30:01	-78.7	116.1	92	0.33	276.1
01/06/1995	15:20:53	78.0	-72.3	97	-0.51	275.3
01/15/1995	17:06:50	78.7	-102.9	82	0.05	276.0
01/15/1995	17:57:42	-78.3	66.7	9	0.05	276.0
01/24/1995	20:34:34	78.2	-152.0	43	-0.02	276.0
01/24/1995	19:43:44	-78.7	37.5	99	-0.01	276.1

08/22/1995	03:32:03	-78.7	-78.4	18	-0.09	-80.5	04/05/1996	07:52:31	-78.8	-142.0	80	-0.09	-75.6
08/31/1995	05:17:35	-78.9	-106.0	73	-0.02	-80.3	04/14/1996	08:46:43	79.3	20.3	92	-0.02	-75.3
08/31/1995	06:08:21	78.5	64.3	55	-0.02	-80.3	04/14/1996	09:37:34	-78.9	-169.3	35	-0.02	-75.3
09/09/1995	07:53:52	78.7	36.7	8	0.05	-80.0	04/23/1996	11:22:36	-79.1	163.3	10	-0.03	-75.1
09/18/1995	09:39:22	78.8	9.2	38	0.05	-79.8	05/02/1996	13:07:37	-79.3	135.9	54	-0.02	-74.9
09/18/1995	10:30:16	-78.5	178.8	62	0.05	-79.8	05/02/1996	13:58:23	78.8	-53.6	76	-0.02	-74.9
09/27/1995	11:24:51	79.0	-18.4	88	0.04	-79.7	05/11/1996	14:52:36	-79.4	108.5	94	0.04	-74.6
09/27/1995	12:15:44	-78.7	151.1	11	0.04	-79.7	05/11/1996	15:43:21	79.0	-80.7	41	0.04	-74.6
10/06/1995	14:01:10	-78.9	123.7	36	0.04	-79.5	05/20/1996	17:28:19	79.1	-107.9	7	0.04	-74.4
10/15/1995	15:46:35	-79.0	96.3	81	-0.03	-79.4	05/29/1996	19:13:15	79.2	-134.7	22	-0.03	-74.3
10/15/1995	16:37:27	78.6	-93.3	54	-0.03	-79.4	05/29/1996	20:04:08	-78.8	35.2	86	-0.03	-74.3
10/24/1995	18:22:52	78.8	-120.8	4	0.04	-79.2	06/07/1996	20:58:10	79.3	-161.6	51	-0.03	-74.0
11/11/1995	21:53:37	79.1	-175.8	93	-0.01	-78.8	06/07/1996	21:49:02	-79.0	8.3	59	-0.03	-74.0
11/11/1995	22:44:24	-78.7	-5.6	32	-0.01	-78.8	06/16/1996	22:43:05	79.4	171.2	78	0.05	-73.7
11/21/1995	00:29:45	-78.9	-33.1	12	0.04	-78.6	06/16/1996	23:33:54	-79.0	-18.5	36	0.05	-73.7
11/30/1995	02:15:04	-79.0	-60.3	54	0.05	-78.4	06/26/1996	00:27:58	79.5	144.5	98	-0.02	-73.5
11/30/1995	03:05:56	78.6	109.6	57	0.05	-78.4	06/26/1996	01:18:46	-79.1	-45.3	20	-0.02	-73.5
12/09/1995	04:51:13	78.8	82.2	13	-0.02	-78.3	07/05/1996	03:03:36	-79.2	-71.8	6	-0.09	-73.3
12/09/1995	04:00:23	-79.2	-87.8	99	-0.07	281.8	07/14/1996	04:48:25	-79.2	-98.2	3	-0.09	-73.1
12/18/1995	06:36:29	79.0	54.8	26	-0.02	281.9	07/23/1996	06:33:13	-79.3	-124.5	10	0.05	-72.7
12/18/1995	07:27:21	-78.5	-134.9	98	-0.02	281.9	08/01/1996	08:18:01	-79.3	-150.8	13	-0.03	-72.6
12/27/1995	08:21:43	79.1	27.6	65	0.05	282.2	08/10/1996	10:02:48	-79.3	-177.3	16	-0.09	-72.4
12/27/1995	09:12:37	-78.7	-162.3	53	0.05	282.2	08/19/1996	11:47:33	-79.3	156.7	18	-0.01	-72.0
01/05/1996	10:57:50	-78.8	170.4	9	0.06	282.5	08/28/1996	13:32:18	-79.3	130.3	19	0.05	-71.8
01/14/1996	12:43:03	-79.0	142.9	36	0.04	282.6	09/06/1996	15:17:01	-79.4	104.2	18	-0.01	-71.6
01/23/1996	14:28:14	-79.2	115.6	80	-0.09	282.7	09/15/1996	17:01:43	-79.4	77.9	17	0.05	-71.3
01/23/1996	15:19:01	78.7	-73.8	60	-0.09	282.7	09/24/1996	18:46:23	-79.4	51.8	14	0.04	-71.1
02/01/1996	17:04:12	78.8	-101.0	20	-0.03	282.9	10/03/1996	20:31:02	-79.4	25.6	11	0.04	-70.8
02/10/1996	18:49:23	79.0	-128.4	24	-0.09	283.1	10/12/1996	22:15:39	-79.4	-0.5	9	0.04	-70.6
02/10/1996	19:40:13	-78.7	41.4	83	-0.09	283.1	10/22/1996	00:00:15	-79.4	-26.6	7	0.05	-70.3
02/19/1996	20:34:33	79.2	-155.9	69	-0.03	283.3	10/31/1996	01:44:50	-79.4	-52.8	6	0.05	-70.1
02/19/1996	21:25:21	-78.8	14.1	43	-0.03	283.3	11/09/1996	03:29:24	-79.4	-78.9	5	0.05	-69.8
02/28/1996	23:10:28	-79.0	-13.0	5	0.05	-76.3	11/18/1996	05:13:57	-79.4	-105.0	4	0.05	-69.6
03/09/1996	00:55:35	-79.1	-40.4	35	0.06	-76.1	11/27/1996	06:58:29	-79.5	-131.2	4	-0.02	-69.4
03/09/1996	01:46:29	78.7	129.8	88	0.06	-76.1	12/06/1996	08:43:00	-79.5	-157.3	7	-0.01	-69.0
03/18/1996	02:40:41	-79.3	-67.8	79	0.05	-75.9	12/15/1996	10:27:31	-79.5	176.4	7	-0.03	291.1
03/18/1996	03:31:35	78.9	102.3	40	0.05	-75.9	12/24/1996	12:12:00	-79.5	150.2	10	0.05	291.5
03/27/1996	05:16:39	79.0	75.1	4	-0.02	-75.8	01/02/1997	13:56:27	-79.5	124.2	13	-0.03	291.7
04/05/1996	07:01:42	79.2	47.6	50	-0.09	-75.6	01/11/1997	15:40:54	-79.6	97.8	16	0.04	292.0

01/20/1997	17:25:19	-79.6	71.5	17	-0.03	292.2	09/13/1997	13:42:17	79.9	-52.6	2	-0.03	-60.2
01/29/1997	19:09:42	-79.6	45.4	20	-0.03	292.5	09/22/1997	15:26:09	79.9	-78.0	31	-0.14	-59.9
02/07/1997	20:54:04	-79.6	19.2	24	0.04	292.8	10/01/1997	16:19:14	-80.2	85.8	83	-0.03	-59.6
02/16/1997	22:38:25	-79.7	-7.0	26	0.04	293.1	10/01/1997	17:09:59	79.8	-103.0	61	-0.03	-59.6
02/26/1997	00:22:44	-79.7	-33.1	32	0.05	-66.6	10/01/1997	17:10:00	79.8	-103.3	61	-0.03	-59.6
02/26/1997	01:13:35	79.3	137.5	100	-0.01	-66.6	10/10/1997	18:03:03	-80.1	60.5	52	-0.03	-59.3
03/07/1997	02:07:03	-79.7	-59.4	38	-0.09	-66.4	10/10/1997	18:53:49	79.8	-128.4	88	-0.03	-59.3
03/07/1997	02:57:56	79.4	111.1	91	-0.09	-66.4	10/19/1997	19:46:50	-80.1	35.4	24	-0.03	-59.0
03/16/1997	03:51:22	-79.8	-85.9	47	0.06	-66.0	10/28/1997	21:30:35	-80.0	10.3	4	-0.03	-58.6
03/16/1997	04:42:15	79.4	84.8	81	0.06	-66.0	11/06/1997	23:14:19	-80.0	-15.0	30	0.04	-58.3
03/25/1997	05:35:39	-79.8	-112.2	59	0.05	-65.7	11/16/1997	00:07:15	80.2	148.5	92	-0.03	-58.0
03/25/1997	06:26:33	79.5	58.4	70	0.05	-65.7	11/16/1997	00:58:02	-79.9	-40.4	52	-0.03	-58.0
04/03/1997	07:19:56	-79.8	-138.6	71	-0.02	-65.5	11/25/1997	01:50:57	80.2	123.3	66	0.05	-57.6
04/03/1997	08:10:50	79.5	31.9	60	-0.02	-65.5	11/25/1997	02:41:43	-79.9	-65.6	76	0.05	-57.6
04/12/1997	09:04:12	-79.9	-165.0	84	-0.03	-65.3	12/04/1997	03:34:38	80.2	97.7	44	-0.03	-57.4
04/12/1997	09:55:04	79.5	5.7	49	-0.03	-65.3	12/04/1997	04:25:23	-79.8	-91.0	94	-0.03	-57.4
04/21/1997	10:48:27	-79.9	168.6	95	-0.03	-65.0	12/13/1997	05:18:15	80.1	72.7	20	-0.03	-57.0
04/21/1997	11:39:17	79.6	-20.5	42	-0.03	-65.0	12/22/1997	07:01:52	80.1	47.2	7	0.05	303.4
04/30/1997	13:23:29	79.6	-46.9	32	-0.03	-64.7	12/31/1997	08:45:26	80.1	22.0	27	-0.03	303.6
05/09/1997	15:07:40	79.7	-73.3	24	-0.03	-64.4	01/09/1998	10:28:59	80.0	-3.3	50	-0.03	304.0
05/18/1997	16:51:49	79.7	-99.4	19	0.04	-64.0	01/09/1998	10:29:00	80.0	-3.6	51	-0.03	304.0
05/27/1997	18:35:58	79.7	-125.6	17	0.04	-63.7	01/18/1998	11:21:45	-80.3	159.7	86	0.04	304.3
06/05/1997	20:20:05	79.7	-151.5	16	0.04	-63.4	01/18/1998	12:12:31	80.0	-28.8	69	0.04	304.3
06/14/1997	22:04:12	79.8	-177.6	22	-0.03	-63.2	01/27/1998	13:05:16	-80.3	134.4	68	-0.03	304.6
06/23/1997	23:48:17	79.7	156.6	28	-0.03	-62.9	01/27/1998	13:56:02	80.0	-54.4	83	-0.03	304.6
07/03/1997	00:41:29	-80.0	-39.6	89	0.05	-62.5	02/05/1998	14:48:46	-80.3	109.1	45	-0.03	304.9
07/03/1997	01:32:21	79.7	130.9	42	0.05	-62.5	02/05/1998	15:39:31	79.9	-79.6	100	-0.00	305.1
07/12/1997	02:25:29	-80.0	-65.1	69	-0.02	-62.3	02/14/1998	16:32:14	-80.2	83.7	28	0.04	305.4
07/12/1997	03:16:22	79.7	105.5	60	-0.02	-62.3	02/23/1998	18:15:41	-80.2	58.2	11	-0.03	-54.4
07/21/1997	04:09:29	-80.0	-90.6	48	-0.02	-62.0	03/04/1998	19:59:05	-80.2	32.8	2	-0.03	-54.0
07/21/1997	05:00:23	79.6	80.0	82	-0.02	-62.0	03/13/1998	21:42:29	-80.2	7.2	12	0.04	-53.6
07/30/1997	05:53:28	-79.9	-116.0	25	-0.03	-61.7	03/22/1998	23:25:51	-80.2	-18.5	18	-0.03	-53.3
08/08/1997	07:37:27	-79.9	-141.3	2	0.05	-61.3	04/01/1998	01:09:11	-80.2	-44.2	21	-0.03	-53.0
08/17/1997	08:30:37	80.1	22.5	98	-0.03	-61.1	04/10/1998	02:52:31	-80.2	-70.1	26	0.05	-52.5
08/17/1997	09:21:25	-79.8	-166.7	29	-0.03	-61.1	04/19/1998	04:35:48	-80.2	-95.7	28	-0.03	-52.3
08/26/1997	10:14:31	80.1	-2.4	65	0.05	-60.7	04/28/1998	05:28:15	80.5	67.6	95	0.04	-51.9
08/26/1997	11:05:21	-79.8	168.2	59	0.05	-60.7	04/28/1998	06:19:04	-80.2	-121.7	29	0.04	-51.9
09/04/1997	11:58:25	80.0	-27.6	32	-0.03	-60.5	05/07/1998	07:11:27	80.5	42.1	90	-0.03	-51.6
09/04/1997	12:49:17	-79.7	142.8	89	-0.03	-60.5	05/07/1998	08:02:18	-80.2	-147.4	30	-0.03	-51.6

05/16/1998	08:54:38	80.5	16.2	84	0.04	-51.2	12/11/1998	00:19:22	80.7	144.3	97	-0.03	-42.9
05/16/1998	09:45:30	-80.3	-173.1	35	0.04	-51.2	12/11/1998	01:10:07	-80.5	-43.9	53	-0.03	-42.9
05/25/1998	10:37:47	80.5	-9.6	83	-0.03	-50.9	12/20/1998	02:01:38	80.7	119.0	84	0.04	-42.4
05/25/1998	11:28:40	-80.3	161.3	39	-0.03	-50.9	12/20/1998	02:52:24	-80.5	-69.6	54	0.04	-42.4
06/03/1998	12:20:55	80.5	-35.4	83	-0.03	-50.6	12/29/1998	03:43:51	80.7	93.8	74	-0.03	317.9
06/03/1998	13:11:48	-80.2	135.8	45	-0.03	-50.6	12/29/1998	04:34:38	-80.5	-95.1	53	-0.03	317.9
06/12/1998	14:04:01	80.5	-61.1	89	-0.03	-50.2							
06/12/1998	14:54:55	-80.3	109.9	48	-0.03	-50.2							
06/21/1998	15:47:07	80.5	-87.0	90	-0.03	-49.9							
06/21/1998	16:38:00	-80.3	84.3	55	-0.03	-49.9							
06/30/1998	17:30:12	80.5	-113.0	96	-0.03	-49.5							
06/30/1998	18:21:03	-80.3	58.6	57	-0.03	-49.5							
07/09/1998	19:13:15	80.6	-138.8	97	0.04	-49.1							
07/09/1998	20:04:04	-80.3	33.1	60	0.04	-49.1							
07/18/1998	20:56:16	80.6	-164.5	98	0.03	-48.7							
07/18/1998	21:47:04	-80.3	7.2	61	0.03	-48.7							
07/27/1998	22:39:16	80.6	169.7	99	0.03	-48.4							
07/27/1998	23:30:02	-80.3	-18.5	56	0.03	-48.4							
08/06/1998	00:22:14	80.6	144.0	96	-0.03	-48.0							
08/06/1998	01:13:00	-80.3	-44.6	51	-0.03	-48.0							
08/15/1998	02:05:10	80.6	118.2	95	-0.03	-47.7							
08/15/1998	02:55:56	-80.4	-70.5	43	-0.03	-47.7							
08/24/1998	03:48:03	80.6	92.6	95	-0.03	-47.3							
08/24/1998	04:38:51	-80.4	-96.6	34	-0.03	-47.3							
09/02/1998	05:30:55	80.6	66.7	93	-0.03	-47.0							
09/02/1998	06:21:43	-80.4	-122.2	29	-0.03	-47.0							
09/11/1998	07:13:42	80.6	41.3	92	-0.03	-46.6							
09/11/1998	08:04:33	-80.4	-148.2	25	-0.03	-46.6							
09/20/1998	08:56:29	80.6	15.2	95	-0.03	-46.2							
09/20/1998	09:47:21	-80.5	-174.0	23	-0.03	-46.2							
09/29/1998	10:39:12	80.6	-10.3	100	-0.03	-45.9							
09/29/1998	11:30:06	-80.5	160.3	24	-0.03	-45.9							
10/08/1998	13:12:47	80.5	134.9	30	-0.03	-45.5							
10/17/1998	14:55:25	-80.5	109.4	36	-0.03	-45.2							
10/26/1998	16:38:00	80.5	83.8	41	-0.03	-44.8							
11/04/1998	18:20:32	-80.5	58.3	47	-0.03	-44.4							
11/13/1998	20:03:01	80.5	32.7	50	0.04	-44.0							
11/22/1998	21:45:25	-80.5	7.3	52	0.04	-43.6							
12/01/1998	23:27:49	-80.5	-18.5	55	-0.04	-43.3							
06/07/1998	01:22:58	79.4	146.2	81	-0.05	71.6							
06/07/1998	02:13:49	-78.9	-49.8	64	-0.05	71.6							
06/16/1998	03:57:10	-79.5	-71.7	96	0.03	71.6							
06/16/1998	04:47:59	79.2	93.3	2	0.03	71.6							
06/16/1998	04:48:00	79.1	93.1	6	0.03	71.6							
06/25/1998	07:22:10	-79.2	-124.7	18	0.01	71.3							
06/25/1998	08:13:00	78.9	40.4	75	0.01	71.3							
07/04/1998	10:47:10	-79.0	-177.6	52	0.03	71.2							
07/13/1998	13:21:19	79.3	-33.8	34	0.03	71.0							
07/22/1998	15:55:24	-79.5	109.0	82	0.03	70.9							
07/22/1998	16:46:16	79.1	-86.9	42	0.03	70.9							
07/31/1998	19:20:20	-79.3	56.1	22	0.03	70.7							
08/19/1998	01:19:15	79.2	145.8	16	0.03	70.3							
08/28/1998	03:53:15	-79.5	-70.2	82	0.03	70.1							
08/28/1998	04:44:04	79.0	93.1	88	0.03	70.1							
09/06/1998	07:18:02	-79.3	-122.9	12	-0.04	69.9							
09/15/1998	09:51:55	79.4	19.5	42	0.03	69.8							
09/15/1998	10:42:47	-79.1	-175.7	59	0.03	69.8							
09/24/1998	13:16:38	79.3	-32.9	10	-0.04	69.5							
10/03/1998	15:50:31	-79.5	110.3	62	0.03	69.4							
10/03/1998	16:41:19	79.1	-85.2	58	0.03	69.4							
10/12/1998	19:15:08	-79.3	58.0	4	0.03	69.2							
10/21/1998	22:39:43	-79.2	5.7	52	0.03	69.0							
10/31/1998	01:13:26	79.6	150.2	66	0.03	68.8							
10/31/1998	02:04:16	-79.0	-46.5	97	0.03	68.8							
11/09/1998	04:37:58	79.4	97.9	25	0.03	68.6							
11/18/1998	07:11:34	-79.6	-118.5	97	-0.04	68.3							
11/18/1998	08:02:25	79.3	46.0	14	-0.04	68.3							
11/27/1998	10:35:58	-79.6	-170.1	72	-0.04	68.1							
11/27/1998	11:26:49	79.2	-5.9	57	-0.04	68.1							

Class I SNOs between NOAA-15 and NOAA-14

Date Time Lat Lon  $\delta$   $\epsilon$  ARAAN

12/06/1998	14:00:20	-79.5	138.5	48	0.03	-292.0	08/10/1999	13:04:07	-79.9	155.3	51	0.00	61.3
12/06/1998	14:51:11	79.1	-57.8	99	0.03	-292.0	08/10/1999	13:54:56	79.5	-40.7	91	0.00	61.3
12/15/1998	17:24:39	-79.5	87.0	33	0.03	-292.2	08/19/1999	16:27:09	-80.0	105.7	95	0.00	61.1
12/24/1998	20:48:55	-79.5	35.7	17	0.03	-292.4	08/19/1999	17:17:58	79.6	-90.8	66	0.00	61.1
01/02/1999	23:22:19	79.7	179.0	85	-0.04	-292.7	08/28/1999	20:40:58	79.7	-141.0	41	0.00	60.8
01/03/1999	00:13:09	-79.4	-15.7	0	0.03	-292.7	09/07/1999	00:03:52	79.8	169.3	10	0.00	60.5
01/12/1999	02:46:28	79.7	127.8	76	0.03	-292.9	09/07/1999	00:54:42	-79.5	-25.5	95	0.00	60.5
01/12/1999	03:37:19	-79.4	-67.2	15	0.03	-292.9	09/16/1999	03:26:44	79.9	119.7	31	0.00	60.2
01/21/1999	06:10:36	79.7	77.0	77	0.03	-293.1	09/16/1999	04:17:34	-79.7	-75.1	57	0.00	60.2
01/21/1999	07:01:27	-79.4	-118.2	28	0.03	-293.1	09/25/1999	06:49:34	80.0	70.4	79	0.00	59.9
01/30/1999	09:34:41	79.7	26.3	82	0.02	-293.4	09/25/1999	07:40:25	-79.7	-125.1	21	0.00	59.9
01/30/1999	10:25:33	-79.3	-169.6	41	0.02	-293.4	10/04/1999	11:03:11	-79.9	-174.5	18	0.00	59.7
02/08/1999	12:58:44	79.8	-24.3	95	-0.04	66.4	10/13/1999	14:25:55	-80.0	135.9	59	0.00	59.4
02/08/1999	13:49:35	-79.3	139.5	47	-0.04	66.4	10/13/1999	15:16:44	79.6	-60.2	72	0.00	59.4
02/17/1999	17:13:37	-79.3	88.4	50	0.03	66.2	10/22/1999	18:39:23	79.8	-109.2	8	0.00	59.1
02/26/1999	20:37:34	-79.4	37.7	44	0.03	66.0	10/31/1999	22:01:58	80.0	-158.0	57	0.00	58.8
03/08/1999	00:01:29	-79.4	-12.8	28	0.03	65.7	11/10/1999	02:15:18	-79.8	-43.6	44	0.00	58.5
03/17/1999	03:25:21	-79.5	-63.0	4	0.03	65.5	11/19/1999	05:37:44	-80.0	-92.5	30	0.00	58.2
03/26/1999	06:49:10	-79.6	-113.1	30	-0.04	65.2	11/19/1999	06:28:33	79.7	72.5	68	0.00	58.2
03/26/1999	07:40:00	79.3	51.5	86	-0.04	65.2	11/28/1999	09:50:52	79.9	23.7	9	0.00	57.9
04/04/1999	10:12:57	-79.8	-162.9	71	-0.04	64.9	12/07/1999	13:13:05	80.1	-24.9	86	0.00	-302.4
04/04/1999	11:03:47	79.4	1.2	64	-0.04	64.9	12/07/1999	14:03:53	-79.8	139.2	56	0.00	-302.4
04/13/1999	14:27:32	79.4	-49.2	41	0.03	64.8	12/16/1999	17:26:03	-80.0	91.0	42	0.00	-302.7
04/22/1999	17:51:13	79.6	-99.3	11	0.03	64.5	12/25/1999	21:38:56	79.9	-153.7	19	0.00	-303.0
05/01/1999	21:14:52	79.7	-149.3	24	0.03	64.3	01/04/2000	01:00:55	80.2	158.5	77	0.00	-303.4
05/01/1999	22:05:42	-79.4	15.9	61	0.03	64.3	01/04/2000	01:51:45	-79.9	-36.7	14	0.00	-303.4
05/11/1999	00:38:29	79.8	160.8	62	0.03	64.0	01/13/2000	05:13:43	-80.2	-84.4	92	0.00	-303.7
05/11/1999	01:29:19	-79.5	-33.9	23	0.03	64.0	01/13/2000	06:04:31	79.7	78.4	93	0.00	-303.7
05/20/1999	04:52:52	-79.7	-83.8	12	0.03	63.7	01/22/2000	09:26:24	80.1	30.9	21	0.00	-304.0
05/29/1999	08:16:22	-79.8	-133.7	42	0.03	63.5	01/22/2000	10:17:14	-79.8	-164.1	70	0.00	-304.0
06/07/1999	11:39:50	-79.9	176.1	70	0.03	63.2	01/31/2000	13:39:03	-80.1	148.1	38	0.00	55.7
06/07/1999	12:30:38	79.5	-19.8	64	0.03	63.2	02/09/2000	17:51:38	80.0	-95.6	2	0.00	55.4
06/16/1999	15:03:14	-79.9	126.0	100	-0.04	62.9	02/18/2000	22:04:09	-80.0	21.1	5	0.00	55.1
06/16/1999	15:54:02	79.6	-69.5	15	-0.04	62.9	02/28/2000	02:16:34	80.1	138.5	7	0.00	54.7
06/25/1999	19:27:23	79.7	-119.2	26	0.00	62.7	03/08/2000	06:28:56	-80.0	-105.5	23	0.00	54.4
07/04/1999	22:40:41	79.9	-168.9	65	0.00	62.4	03/17/2000	10:41:08	80.1	12.7	15	0.00	54.1
07/14/1999	02:54:43	-79.5	-55.5	69	0.00	62.1	03/26/2000	14:53:16	-80.1	129.0	15	0.00	53.7
07/23/1999	06:17:54	-79.6	-105.4	29	0.00	61.9	04/04/2000	19:05:15	80.2	-112.7	36	0.00	53.4
08/01/1999	09:41:02	-79.8	-154.9	12	0.00	61.6	04/13/2000	23:16:59	-80.3	4.9	56	0.00	53.1



04/14/2000	00:07:47	79.9	168.9	79	0.00	53.0	12/18/2000	00:27:19	80.3	166.8	65	0.02	-316.9
04/23/2000	03:28:34	80.3	122.9	83	0.03	52.7	12/27/2000	04:36:33	-80.6	-72.9	27	-0.05	-317.3
04/23/2000	04:19:23	-80.1	-72.8	36	0.03	52.7	01/05/2001	09:36:28	-80.5	-148.8	2	-0.04	-317.7
05/02/2000	08:30:53	80.1	44.6	25	-0.05	52.3	01/14/2001	13:45:31	80.6	-29.1	72	-0.04	-318.1
05/11/2000	12:42:16	-80.3	164.1	57	0.03	52.1	01/14/2001	14:36:20	-80.5	135.6	27	-0.04	-318.1
05/20/2000	16:53:34	80.3	-79.1	42	0.03	51.7	01/23/2001	18:45:19	80.6	-104.6	39	0.03	41.6
05/20/2000	17:44:23	-80.1	86.0	45	0.03	51.7	01/23/2001	19:36:08	-80.4	60.1	54	0.03	41.6
05/29/2000	21:55:35	80.1	-157.1	57	0.04	51.4	02/01/2001	23:45:04	80.6	179.9	17	-0.04	41.1
06/08/2000	02:06:43	-80.3	-37.8	24	-0.05	50.9	02/02/2001	00:35:52	-80.4	-15.3	80	0.02	41.1
06/17/2000	06:17:45	80.3	80.2	45	0.02	50.6	02/11/2001	04:44:45	80.6	104.6	2	0.02	40.7
06/17/2000	07:08:33	-80.0	-115.7	89	0.02	50.6	02/20/2001	09:44:22	80.6	29.6	9	0.03	40.3
06/26/2000	10:28:43	-80.4	-161.7	72	0.03	50.3	03/01/2001	14:43:57	80.5	-45.6	15	0.03	39.9
06/26/2000	11:19:32	80.1	2.3	52	0.03	50.3	03/10/2001	18:52:39	-80.8	75.5	99	-0.04	39.5
07/05/2000	15:30:25	-80.2	120.2	40	-0.04	49.8	03/10/2001	19:43:28	80.5	-120.5	18	-0.04	39.5
07/14/2000	19:41:16	80.3	-120.7	31	-0.04	49.5	03/19/2001	23:52:06	-80.7	0.2	83	0.04	39.2
07/23/2000	23:51:58	-80.4	-3.2	28	0.03	49.2	03/20/2001	00:42:54	80.6	164.9	23	0.02	39.1
07/24/2000	00:42:47	80.1	161.4	74	-0.05	49.1	03/29/2001	04:51:28	-80.7	-74.8	74	0.02	38.7
08/02/2000	04:02:34	80.5	115.8	94	-0.04	48.8	03/29/2001	05:42:16	80.6	89.9	26	0.02	38.7
08/02/2000	04:53:23	-80.1	-81.5	79	-0.04	48.8	04/07/2001	09:50:37	-80.8	-149.4	81	0.03	38.3
08/11/2000	09:03:54	80.3	37.8	19	0.03	48.5	04/07/2001	10:41:25	80.6	15.0	25	0.03	38.3
08/20/2000	13:14:21	-80.3	155.7	8	0.03	48.1	04/16/2001	14:49:37	-80.8	136.3	90	-0.04	37.8
08/29/2000	17:24:41	80.4	-85.8	37	-0.04	47.7	04/16/2001	15:40:24	80.6	-59.6	30	-0.04	37.8
08/29/2000	18:15:31	-80.1	78.3	79	-0.04	47.7	04/25/2001	20:39:21	80.6	-134.7	39	0.03	37.4
09/07/2000	22:25:49	80.2	-164.2	78	-0.04	47.3	04/25/2001	19:48:34	-80.8	61.7	100	-0.00	37.2
09/17/2000	02:36:03	-80.4	-44.3	11	-0.05	46.9	05/05/2001	01:38:11	80.6	150.5	46	-0.05	36.9
09/26/2000	06:46:13	80.4	73.1	8	0.02	46.6	05/14/2001	06:36:56	80.6	75.8	57	0.02	36.6
09/26/2000	07:37:01	-80.2	-121.7	85	0.02	46.6	05/23/2001	11:35:39	80.5	0.8	66	0.03	36.1
10/05/2000	11:47:07	80.2	-4.3	79	0.03	46.2	06/01/2001	16:34:18	80.5	-73.9	72	-0.04	35.6
10/14/2000	15:57:04	-80.4	115.7	5	0.03	45.9	06/10/2001	21:32:54	80.5	-148.8	75	0.04	35.3
10/23/2000	20:06:58	80.5	-125.6	47	-0.04	45.5	06/20/2001	01:40:38	-80.8	-26.2	96	-0.05	34.7
10/23/2000	20:57:46	-80.2	38.1	95	-0.04	45.5	06/20/2001	02:31:26	80.5	136.7	77	-0.05	34.7
11/02/2000	01:07:35	80.4	157.5	20	0.02	45.1	06/29/2001	06:39:05	-80.8	-101.3	77	-0.04	34.3
11/02/2000	00:16:46	-80.6	-6.6	99	-0.05	45.0	06/29/2001	07:29:53	80.6	62.2	76	-0.04	34.3
11/11/2000	05:17:14	-80.5	-83.8	18	0.02	44.7	07/08/2001	11:37:28	-80.8	-176.1	56	0.03	34.0
11/11/2000	06:08:03	80.2	80.7	87	0.02	44.7	07/08/2001	12:28:17	80.6	-12.4	76	0.03	34.0
11/20/2000	10:17:35	-80.3	-160.8	62	0.03	44.4	07/17/2001	16:35:50	-80.8	108.6	36	0.03	33.6
11/29/2000	14:27:06	80.6	-39.9	63	0.03	43.9	07/17/2001	17:26:38	80.6	-86.9	79	0.03	33.6
12/08/2000	19:27:13	80.5	-116.7	7	0.04	-316.4	07/26/2001	21:34:08	-80.8	33.8	19	-0.04	33.1
12/17/2000	23:36:31	-80.6	3.1	68	-0.04	-316.9	07/26/2001	22:24:56	80.6	-161.6	85	-0.04	33.1

08/05/2001	02:32:25	-80.7	-41.2	6	0.02	32.7	04/01/2002	06:54:00	80.8	71.6	32	-0.04	20.8
08/05/2001	03:23:12	80.6	123.5	98	0.02	32.7	04/01/2002	06:53:59	80.8	73.1	32	0.01	20.7
08/14/2001	07:30:39	-80.7	-116.0	4	-0.04	32.2	04/10/2002	10:58:08	-80.9	-168.3	19	0.03	20.3
08/23/2001	12:28:50	-80.7	169.4	10	-0.04	31.8	04/10/2002	11:48:54	80.7	-3.5	91	0.03	20.3
09/01/2001	17:26:59	-80.7	94.6	17	0.03	31.4	04/19/2002	15:52:55	-80.8	116.7	39	0.03	19.9
09/10/2001	22:25:04	-80.7	19.9	22	-0.04	30.9	04/28/2002	19:56:48	81.0	-121.9	80	0.03	19.4
09/20/2001	02:32:14	80.9	141.1	84	-0.05	30.4	04/28/2002	20:47:35	-80.7	41.4	93	0.03	19.4
09/20/2001	03:23:03	-80.7	-54.5	24	-0.05	30.4	05/08/2002	00:51:22	80.8	162.5	0	0.03	18.9
09/29/2001	07:30:08	80.9	66.4	68	-0.04	30.0	05/17/2002	04:55:07	-81.0	-76.7	78	-0.04	18.4
09/29/2001	08:20:56	-80.7	-128.9	33	-0.04	30.0	05/17/2002	05:45:50	80.7	86.8	87	-0.04	18.4
10/08/2001	12:27:52	80.9	-8.3	58	0.03	29.6	05/26/2002	09:49:31	-80.8	-152.4	0	0.03	18.0
10/08/2001	13:18:40	-80.7	156.2	43	0.03	29.6	06/04/2002	13:53:03	80.9	-32.9	25	0.03	17.5
10/17/2001	17:25:30	80.9	-83.3	47	-0.04	29.1	06/04/2002	14:43:50	-80.7	131.9	86	0.03	17.5
10/17/2001	18:16:16	-80.7	81.4	64	-0.04	29.1	06/13/2002	18:47:18	80.7	-108.6	70	0.03	17.0
10/26/2001	22:22:59	80.9	-157.7	39	0.03	28.7	06/22/2002	22:50:46	-80.8	12.1	22	0.03	16.6
10/26/2001	23:13:45	-80.7	6.3	89	0.03	28.7	07/02/2002	02:54:11	80.9	131.5	42	-0.05	16.0
11/05/2001	03:20:12	80.9	127.7	26	-0.05	28.1	07/02/2002	03:44:54	-80.7	-63.7	87	-0.05	16.0
11/14/2001	08:17:18	80.8	52.8	8	-0.05	27.7	07/11/2002	07:48:18	80.7	55.7	54	-0.04	15.5
11/23/2001	13:14:14	80.8	-21.7	12	-0.04	27.2	07/20/2002	11:51:36	-80.8	175.4	14	0.03	15.1
12/02/2001	17:20:17	-80.9	98.5	70	-0.04	26.8	07/29/2002	15:54:57	80.8	-64.9	48	-0.04	14.6
12/02/2001	18:11:04	80.8	-96.8	36	-0.04	26.8	08/07/2002	19:58:10	-80.8	53.9	51	-0.04	14.1
12/11/2001	22:17:00	-80.9	23.7	41	0.03	-333.6	08/07/2002	20:48:54	80.7	-140.6	64	0.03	14.1
12/11/2001	23:07:47	80.7	-171.9	68	0.03	-333.6	08/17/2002	00:52:07	-80.6	-22.4	70	0.03	13.7
12/11/2001	22:16:59	-80.9	23.9	43	-0.06	-333.8	08/26/2002	04:55:15	80.7	97.5	5	0.02	13.1
12/21/2001	03:13:34	-80.9	-51.2	16	-0.05	-334.1	09/04/2002	08:58:20	-80.6	-143.6	0	0.03	12.7
12/30/2001	08:10:01	-80.8	-125.9	9	0.03	-334.5	09/13/2002	13:01:19	80.6	-24.5	31	0.03	12.2
01/08/2002	13:06:16	-80.8	159.3	34	0.03	25.0	09/22/2002	17:04:14	-80.7	95.4	60	-0.04	11.7
01/17/2002	17:11:37	80.9	-79.7	60	-0.04	24.5	10/01/2002	21:07:05	80.6	-147.0	48	0.03	11.3
01/17/2002	18:02:25	-80.8	84.7	62	-0.04	24.5	10/01/2002	21:57:51	-80.4	18.3	72	0.03	11.3
01/26/2002	22:07:38	80.9	-155.1	11	-0.04	24.1	10/11/2002	02:00:35	80.4	137.2	95	-0.02	10.7
01/26/2002	22:58:25	-80.7	9.9	98	-0.04	24.1	10/11/2002	01:09:54	-80.6	-27.0	96	0.02	10.7
02/05/2002	03:03:27	80.8	129.8	38	0.03	23.7	10/20/2002	05:12:38	80.5	90.2	63	0.03	10.3
02/14/2002	07:59:08	80.7	54.6	85	0.03	23.2	10/20/2002	06:03:19	-80.4	-103.4	52	0.03	10.3
02/23/2002	12:03:55	-80.9	176.4	49	-0.04	22.6	10/29/2002	09:15:16	-80.5	-150.6	99	0.03	9.8
03/04/2002	16:59:18	-80.8	101.4	14	-0.04	22.2	10/29/2002	10:05:57	80.3	14.5	82	-0.06	9.6
03/13/2002	21:03:50	80.9	-138.1	72	-0.03	21.8	11/07/2002	14:08:30	-80.3	133.5	64	0.03	9.3
03/13/2002	21:54:34	-80.7	25.5	85	-0.03	21.8	11/07/2002	13:17:49	80.4	-31.8	73	0.01	9.2
03/23/2002	01:58:59	80.9	147.0	24	0.03	21.3	11/16/2002	17:20:23	-80.2	84.6	70	0.03	8.8
04/01/2002	06:03:13	-81.0	-93.0	81	-0.04	20.8	11/16/2002	18:11:02	80.1	-108.6	81	0.03	8.8



11/27/2001	02:14:35	79.8	115.3	76	-0.00	-53.4	08/27/2002	02:10:37	-79.7	-62.4	84	-0.00	-64.0
11/27/2001	03:05:35	-79.8	-77.8	56	-0.00	-53.4	08/27/2002	03:01:35	79.6	105.9	43	-0.00	-64.0
11/27/2001	04:47:37	-79.7	-102.4	94	-0.00	-53.4	08/27/2002	03:52:37	-79.6	-86.9	49	-0.00	-64.0
02/01/2002	21:45:09	-80.1	-0.2	91	0.07	304.1	08/27/2002	04:43:35	79.5	81.4	8	-0.00	-64.0
02/01/2002	23:27:11	-80.0	-25.0	55	0.07	304.1	08/27/2002	05:34:37	-79.5	-111.5	14	-0.00	-64.0
02/02/2002	00:18:12	80.0	142.0	63	0.07	304.1	08/27/2002	06:25:35	79.3	56.8	27	-0.00	-64.0
02/02/2002	01:09:12	-79.9	-49.4	18	0.07	304.1	08/27/2002	07:16:38	-79.4	-136.4	21	-0.00	-64.0
02/02/2002	02:00:13	79.9	117.5	27	0.07	304.1	08/27/2002	08:07:36	79.3	31.9	61	-0.00	-64.0
02/02/2002	02:51:13	-79.8	-73.9	19	0.07	304.1	08/27/2002	08:58:38	-79.3	-160.9	55	-0.00	-64.0
02/02/2002	03:42:14	79.8	93.0	11	0.07	304.1	08/27/2002	09:49:36	79.1	7.3	96	-0.00	-64.0
02/02/2002	04:33:15	-79.7	-98.7	56	0.07	304.1	08/27/2002	10:40:38	-79.2	174.4	89	-0.00	-64.0
02/02/2002	05:24:15	79.7	68.5	47	0.07	304.1	11/04/2002	19:02:12	79.6	-134.0	98	-0.07	-66.6
02/02/2002	06:15:16	-79.6	-123.3	93	0.07	304.1	11/04/2002	19:53:10	-79.5	33.8	74	-0.07	-66.6
02/02/2002	07:06:17	79.6	43.7	84	0.07	304.1	11/04/2002	20:44:12	79.5	-158.6	64	-0.07	-66.6
02/01/2002	22:36:10	80.1	166.9	96	-0.07	303.9	11/04/2002	21:35:10	-79.4	9.1	41	-0.07	-66.6
04/11/2002	01:25:52	79.9	125.8	94	-0.00	-58.7	11/04/2002	22:26:12	79.4	176.7	31	-0.07	-66.6
04/11/2002	03:07:53	79.9	101.2	58	-0.00	-58.7	11/04/2002	23:17:10	-79.3	-15.5	7	-0.07	-66.6
04/11/2002	03:58:54	-79.9	-91.9	73	-0.00	-58.7	11/05/2002	00:08:12	79.2	152.1	6	-0.00	-66.5
04/11/2002	04:49:54	79.8	76.5	21	-0.00	-58.7	11/05/2002	00:59:10	-79.2	-40.1	29	-0.00	-66.5
04/11/2002	05:40:55	-79.8	-116.6	37	-0.00	-58.7	11/05/2002	01:50:12	79.1	127.4	40	-0.00	-66.5
04/11/2002	06:31:54	79.7	52.1	15	-0.00	-58.7	11/05/2002	02:41:10	-79.1	-64.8	63	-0.00	-66.5
04/11/2002	07:22:56	-79.7	-141.2	3	-0.00	-58.7	11/05/2002	03:32:13	79.1	102.5	73	-0.00	-66.5
04/11/2002	08:13:55	79.6	27.5	51	-0.00	-58.7	11/05/2002	04:23:10	-79.0	-89.6	96	-0.00	-66.5
04/11/2002	09:04:56	-79.6	-165.6	35	-0.00	-58.7							
04/11/2002	09:55:56	79.5	2.8	87	-0.00	-58.7							
04/11/2002	10:46:57	-79.5	169.7	71	-0.00	-58.7							
06/18/2002	22:00:15	-79.8	-1.3	96	0.00	-61.4							
06/18/2002	23:42:16	-79.7	-26.1	61	0.00	-61.4							
06/19/2002	00:33:18	79.8	140.9	65	0.00	-61.4							
06/19/2002	01:24:17	-79.7	-50.8	26	0.00	-61.4							
06/19/2002	02:15:18	79.7	116.5	29	0.00	-61.4							
06/19/2002	03:06:17	-79.5	-75.3	10	0.00	-61.4							
06/19/2002	03:57:19	79.6	91.7	6	0.00	-61.4							
06/19/2002	04:48:18	-79.5	-100.1	45	0.00	-61.4							
06/19/2002	05:39:19	79.5	67.2	41	0.00	-61.4							
06/19/2002	06:30:18	-79.3	-124.6	80	0.00	-61.4							
06/19/2002	07:21:20	79.4	42.4	77	0.00	-61.4							
06/18/2002	22:51:17	79.8	165.8	98	0.00	-61.4							
08/27/2002	01:19:34	79.6	130.8	78	-0.00	-64.0							

**Class I SNOs between NOAA-16 and NOAA-15**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
10/08/2000	14:01:51	78.7	-51.0	25	0.39	-81.8
10/08/2000	14:52:41	-78.2	118.6	80	0.39	-81.8
10/16/2000	15:12:16	-78.7	110.9	38	-0.14	-82.4
10/24/2000	16:22:40	78.6	-86.2	11	0.40	-81.8
11/01/2000	17:32:53	-78.7	76.0	27	0.07	-82.2
11/09/2000	18:43:08	78.7	-121.6	23	0.32	-81.9
11/17/2000	19:53:09	-78.6	40.8	26	0.04	-82.2
11/17/2000	20:44:02	78.2	-149.1	97	0.28	-82.0
11/25/2000	21:03:14	78.8	-157.5	57	0.35	-81.9
11/25/2000	21:54:02	-78.2	13.0	86	0.35	-81.9
12/03/2000	22:13:08	-78.8	4.7	68	-0.45	277.3
12/03/2000	23:03:59	78.4	174.7	51	-0.45	277.3

12/12/2000	00:13:50	-78.4	-22.9	46	0.41	278.2	07/17/2001	19:08:42	78.9	-131.1	87	-0.39	-81.8
12/20/2000	01:23:37	78.5	138.7	5	0.28	278.1	07/17/2001	19:59:28	-78.5	39.2	41	-0.39	-81.8
12/28/2000	03:24:11	78.2	110.5	99	0.39	278.2	07/25/2001	21:07:45	78.8	-159.7	37	0.40	-81.0
12/28/2000	02:33:24	-78.7	-59.5	23	0.15	277.9	07/25/2001	21:58:31	-78.3	10.6	96	0.40	-81.0
01/05/2001	03:43:00	78.8	101.9	72	0.19	278.0	08/02/2001	23:06:46	78.6	171.7	15	-0.28	-81.6
01/05/2001	04:33:53	-78.3	-87.7	60	0.19	278.0	08/11/2001	00:14:54	-78.8	-27.0	55	0.06	-81.2
01/13/2001	05:43:27	78.5	73.9	18	-0.38	277.4	08/11/2001	01:05:45	78.4	143.1	69	0.06	-81.2
01/21/2001	06:53:05	-78.7	-125.2	47	0.38	278.2	08/19/2001	02:13:53	-78.7	-55.6	2	-0.10	-81.3
01/29/2001	08:02:34	78.9	36.4	85	0.42	278.3	08/27/2001	03:21:57	79.0	105.2	91	-0.06	-81.2
01/29/2001	08:53:26	-78.5	-153.7	26	0.42	278.3	08/27/2001	04:12:48	-78.5	-84.1	50	-0.06	-81.2
02/06/2001	10:02:52	78.6	8.2	13	0.28	278.2	09/04/2001	05:20:49	78.8	76.8	37	0.13	-81.0
02/06/2001	10:53:43	-78.2	177.8	95	0.28	278.2	09/04/2001	06:11:42	-78.3	-112.9	99	0.36	-80.7
02/14/2001	12:03:08	78.4	-20.5	55	0.26	278.2	09/12/2001	07:19:38	78.6	48.2	13	0.35	-80.7
02/22/2001	13:12:29	-78.7	140.0	38	0.26	278.2	09/20/2001	08:27:37	-79.0	-151.3	90	-0.23	-81.2
03/02/2001	14:21:51	78.9	-58.7	92	0.33	-81.7	09/20/2001	09:18:22	78.5	19.4	51	-0.23	-81.2
03/02/2001	15:12:38	-78.5	111.3	25	0.33	-81.7	09/28/2001	10:26:18	-78.8	-179.9	44	-0.38	-81.3
03/10/2001	16:21:58	78.7	-87.3	36	-0.42	-82.4	10/06/2001	12:24:49	-78.7	151.2	14	0.27	-80.6
03/10/2001	17:12:44	-78.2	82.8	88	-0.42	-82.4	10/14/2001	13:32:24	79.0	-47.9	99	-0.23	-81.1
03/18/2001	18:22:02	78.5	-116.1	18	0.47	-81.5	10/14/2001	14:23:14	-78.6	122.2	16	-0.23	-81.1
03/26/2001	19:31:10	-78.8	44.6	60	0.39	-81.6	10/22/2001	15:30:44	79.0	-77.1	81	-0.01	-80.8
03/26/2001	20:22:03	78.3	-145.3	67	0.39	-81.6	10/22/2001	16:21:32	-78.5	93.0	33	-0.01	-80.8
04/03/2001	21:31:03	-78.6	15.8	7	0.42	-81.5	10/30/2001	17:28:52	79.0	-106.5	73	0.39	-80.3
04/11/2001	23:30:45	-78.5	-13.3	28	0.25	-81.7	10/30/2001	18:19:39	-78.5	63.5	43	0.39	-80.3
04/20/2001	00:39:33	78.8	147.2	68	-0.01	-81.9	11/07/2001	19:26:51	78.9	-135.8	66	0.04	-80.6
04/20/2001	01:30:24	-78.3	-42.2	77	-0.01	-81.9	11/07/2001	20:17:37	-78.5	34.3	55	0.04	-80.6
04/28/2001	02:39:07	78.7	118.4	22	0.41	-81.4	11/15/2001	21:24:43	79.0	-165.5	68	-0.03	-80.6
05/06/2001	04:38:37	78.5	89.4	23	-0.30	-82.1	11/15/2001	22:15:28	-78.5	4.8	57	-0.03	-80.6
05/14/2001	05:47:18	-78.9	-110.0	67	0.26	-81.5	11/23/2001	23:22:26	79.0	165.1	72	-0.02	-80.5
05/14/2001	06:38:03	78.3	60.6	71	0.26	-81.5	11/24/2001	00:13:11	-78.5	-24.5	59	-0.02	-80.5
05/22/2001	07:46:41	-78.7	-139.0	32	0.20	-81.5	12/02/2001	01:20:04	79.0	135.4	80	-0.02	-80.4
05/30/2001	09:46:02	-78.6	-167.9	11	0.04	-81.7	12/02/2001	02:10:50	-78.5	-54.1	54	-0.02	-80.4
06/07/2001	10:54:28	78.8	-6.6	59	0.01	-81.6	12/10/2001	03:17:36	79.1	105.6	93	-0.03	279.6
06/07/2001	11:45:19	-78.4	163.3	54	0.01	-81.6	12/10/2001	04:08:23	-78.5	-83.8	45	-0.03	279.6
06/15/2001	12:53:45	78.7	-35.5	14	-0.00	-81.6	12/18/2001	06:05:48	-78.6	-113.4	32	-0.03	279.7
06/15/2001	13:44:34	-78.2	134.4	98	-0.00	-81.6	12/26/2001	08:03:08	-78.7	-143.4	11	-0.02	279.8
06/23/2001	14:52:58	78.5	-64.2	64	0.33	-81.2	01/03/2002	10:00:19	-78.8	-173.5	21	-0.03	279.9
07/01/2001	16:01:16	-78.9	96.4	64	0.05	-81.5	01/11/2002	11:57:21	-78.9	156.6	49	-0.03	280.0
07/01/2001	16:52:08	78.3	-92.8	85	0.05	-81.5	01/11/2002	12:48:06	78.4	-32.9	86	-0.03	280.0
07/09/2001	18:00:23	-78.7	67.7	14	-0.21	-81.7	01/19/2002	13:54:18	-79.1	126.3	92	-0.02	280.1

01/19/2002	14:45:03	78.6	-63.1	47	-0.02	280.1	08/10/2002	03:38:03	-78.7	-76.7	78	-0.09	-77.3
01/27/2002	16:41:52	78.7	-93.2	8	-0.07	280.2	08/18/2002	05:32:56	-79.0	-107.3	4	-0.09	-77.2
02/04/2002	18:38:33	78.9	-123.7	37	-0.09	280.2	08/26/2002	07:27:46	-79.3	-138.2	87	-0.03	-77.0
02/04/2002	19:29:24	-78.4	46.7	86	-0.09	280.2	08/26/2002	08:18:34	78.8	32.6	51	-0.03	-77.0
02/12/2002	20:35:05	79.1	-154.2	94	-0.03	280.3	09/03/2002	10:13:19	79.1	1.8	32	-0.03	-76.9
02/12/2002	21:25:55	-78.7	16.0	25	-0.03	280.3	09/11/2002	12:58:51	-78.9	141.6	13	-0.09	-76.9
02/20/2002	23:22:20	-78.9	-14.6	34	0.05	280.5	09/19/2002	14:53:28	-79.2	110.6	79	-0.03	-76.7
03/01/2002	02:09:27	78.6	125.6	48	-0.01	-79.4	09/19/2002	15:44:13	78.8	-78.8	61	-0.03	-76.7
03/09/2002	04:05:38	78.9	94.8	27	-0.03	-79.4	09/27/2002	17:38:45	79.1	-109.7	36	-0.03	-76.6
03/09/2002	04:56:24	-78.4	-95.2	93	-0.03	-79.4	09/27/2002	18:29:38	-78.7	60.6	96	-0.03	-76.6
03/17/2002	06:52:28	-78.7	-125.7	26	-0.02	-79.3	10/05/2002	20:24:08	-79.0	29.6	7	-0.02	-76.4
03/25/2002	08:48:27	-79.0	-156.6	50	-0.03	-79.2	10/13/2002	23:09:19	78.9	169.2	38	-0.03	-76.3
03/25/2002	09:39:20	78.5	13.8	90	-0.03	-79.2	10/22/2002	01:03:41	79.3	138.0	72	-0.02	-76.1
04/02/2002	11:35:11	78.8	-16.9	8	-0.03	-79.1	10/22/2002	01:54:31	-78.8	-51.6	58	-0.02	-76.1
04/10/2002	13:30:57	79.1	-48.1	82	-0.02	-79.0	10/30/2002	03:48:48	-79.2	-82.9	51	-0.03	-76.0
04/10/2002	14:21:43	-78.6	122.4	54	-0.02	-79.0	10/30/2002	04:39:35	78.7	88.1	95	-0.03	-76.0
04/18/2002	16:17:24	-79.0	91.4	36	-0.09	-78.9	11/07/2002	06:33:50	79.1	56.5	24	-0.02	-75.9
04/18/2002	17:08:14	78.5	-98.3	97	-0.09	-78.9	11/15/2002	09:18:45	-79.1	-164.5	12	-0.09	-75.8
04/26/2002	19:03:46	78.8	-129.4	2	-0.03	-78.8	11/23/2002	12:03:41	79.0	-25.2	11	-0.03	-75.6
05/04/2002	20:59:15	79.2	-160.5	91	0.05	-78.6	12/01/2002	14:48:27	-79.0	113.7	12	0.04	-75.4
05/12/2002	23:45:31	-78.7	10.1	47	0.05	-78.6	12/09/2002	17:33:17	79.0	-107.2	26	-0.03	-75.3
05/13/2002	00:36:16	78.5	149.4	56	-0.03	-78.6	12/17/2002	20:17:58	-79.0	31.5	25	0.04	284.9
05/21/2002	02:31:35	78.9	118.5	86	0.05	-78.5	12/25/2002	23:02:40	79.0	170.4	35	-0.02	285.0
05/29/2002	05:17:45	-78.8	-102.4	6	-0.02	-78.4	01/03/2003	01:47:16	-79.0	-50.9	31	-0.09	285.1
05/29/2002	04:26:52	79.2	87.3	98	-0.09	-78.4	01/11/2003	04:31:49	79.0	88.1	32	-0.03	285.3
06/06/2002	07:12:57	-79.1	-133.3	58	-0.09	-78.3	01/19/2003	07:16:24	-79.1	-133.4	24	-0.02	285.5
06/06/2002	08:03:42	78.6	37.4	86	-0.09	-78.3	01/27/2003	10:00:49	79.1	5.5	19	-0.09	285.6
06/14/2002	09:58:53	78.9	6.5	3	-0.03	-78.1	02/04/2003	12:45:21	-79.2	143.9	2	-0.03	285.8
06/22/2002	11:54:01	79.2	-24.4	87	-0.03	-78.0	02/12/2003	15:29:42	79.2	-77.5	11	-0.09	285.9
06/22/2002	12:44:50	-78.8	146.0	37	-0.03	-78.0	02/20/2003	18:14:08	-79.3	60.7	32	-0.09	286.0
06/30/2002	14:39:55	-79.1	114.9	51	0.04	-77.8	02/28/2003	20:58:27	79.4	-160.9	51	0.04	-73.7
06/30/2002	15:30:44	78.6	-74.3	97	0.04	-77.8	02/28/2003	21:49:16	-78.9	9.7	85	0.04	-73.7
07/08/2002	17:25:47	78.9	-105.0	9	-0.03	-77.8	03/08/2003	23:42:46	-79.5	-22.7	82	-0.09	-73.7
07/16/2002	19:20:49	79.2	-135.9	77	-0.02	-77.6	03/09/2003	00:33:35	79.0	148.1	62	-0.09	-73.7
07/16/2002	20:11:35	-78.8	34.3	50	-0.02	-77.6	03/17/2003	03:17:49	-79.1	-73.7	32	-0.02	-73.4
07/24/2002	22:06:34	-79.1	3.6	35	-0.09	-77.6	03/25/2003	06:02:06	79.2	64.6	7	-0.02	-73.2
08/02/2002	00:52:23	78.8	143.6	26	-0.09	-77.4	04/02/2003	08:46:15	-79.3	-157.3	29	0.04	-73.0
08/10/2002	02:47:18	79.2	112.8	56	-0.09	-77.3	04/10/2003	11:30:28	79.4	-19.1	57	-0.08	-72.9
							04/10/2003	12:21:12	-79.0	151.6	77	-0.08	-72.9

04/18/2003	14:14:33	-79.5	118.9	93	-0.03	-72.8
04/18/2003	15:05:24	79.1	-70.1	54	-0.03	-72.8
04/26/2003	17:49:27	-79.2	67.7	5	-0.09	-72.6
05/04/2003	20:33:32	79.3	-154.1	24	-0.09	-72.5
05/12/2003	23:17:34	-79.5	-16.7	79	0.04	-72.2
05/13/2003	00:08:21	79.1	154.5	75	-0.09	-72.3
05/21/2003	02:52:23	-79.2	-67.7	26	-0.09	-72.1
05/29/2003	05:36:18	79.3	70.4	9	-0.06	-71.8
06/06/2003	08:20:18	-79.5	-151.8	53	-0.01	-71.6
06/06/2003	09:11:02	79.1	19.1	93	-0.01	-71.6
06/14/2003	11:54:59	-79.2	157.0	41	-0.17	-71.7
06/14/2003	11:04:08	79.6	-13.8	94	-0.02	-71.5
06/14/2003	11:55:00	-79.2	156.8	43	-0.02	-71.5
06/22/2003	14:38:49	79.3	-64.9	11	0.05	-71.3
06/30/2003	17:22:42	-79.4	73.2	27	-0.03	-71.2
07/08/2003	20:06:30	79.6	-148.6	63	-0.08	-71.0
07/08/2003	20:57:18	-79.1	22.2	79	-0.08	-71.0
07/16/2003	22:50:18	-79.7	-10.7	98	0.05	-70.7
07/16/2003	23:41:07	79.3	160.3	45	0.05	-70.7
07/25/2003	02:24:51	-79.4	-61.6	10	-0.02	-70.6
08/02/2003	05:08:38	79.5	76.8	22	-0.03	-70.4
08/10/2003	07:52:18	-79.6	-145.4	65	-0.02	-70.2
08/10/2003	08:43:09	79.2	25.7	82	-0.02	-70.2
08/18/2003	10:36:03	79.7	-7.1	95	0.04	-70.0
08/18/2003	11:26:47	-79.3	163.8	40	0.04	-70.0
08/26/2003	14:10:31	79.4	-58.2	6	-0.09	-69.9
09/03/2003	16:54:07	-79.6	79.7	45	0.04	-69.6
09/11/2003	19:37:45	79.7	-142.2	78	-0.03	-69.5
09/11/2003	20:28:33	-79.3	28.6	53	-0.03	-69.5
09/19/2003	23:12:08	79.4	166.8	22	0.03	-69.3
09/28/2003	01:55:46	-79.6	-55.8	37	0.04	-69.1
10/06/2003	04:39:15	79.7	82.3	79	-0.09	-69.0
10/06/2003	05:30:07	-79.3	-107.0	58	-0.09	-69.0
10/14/2003	08:13:34	79.5	31.0	10	-0.01	-68.7
10/22/2003	10:57:08	-79.7	168.6	46	-0.02	-68.5
10/22/2003	11:47:52	79.2	-20.4	98	-0.02	-68.5
10/30/2003	14:31:23	-79.4	117.2	39	-0.03	-68.4
11/07/2003	17:14:43	79.6	-105.2	28	-0.02	-68.1
11/15/2003	19:58:05	-79.8	32.1	92	-0.09	-68.0

**Class I SNOs between NOAA-17 and NOAA-14**

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta RAAN$
07/05/2002	07:20:30	79.7	98.1	3	-0.05	59.6
07/05/2002	08:11:17	-79.5	-96.6	85	-0.05	59.6
07/15/2002	09:29:12	-79.8	-112.9	42	0.03	59.4
07/15/2002	10:20:01	79.5	51.2	94	0.03	59.4
07/25/2002	11:37:53	79.9	35.4	51	-0.05	59.0
07/25/2002	12:28:39	-79.5	-160.3	79	-0.05	59.0
08/04/2002	13:46:28	-79.9	-176.8	41	0.02	58.8
08/04/2002	14:37:17	79.6	-11.8	55	0.02	58.8
08/14/2002	15:55:01	80.0	-27.6	75	-0.05	58.5
08/14/2002	16:45:48	-79.6	135.8	85	-0.05	58.5
08/24/2002	18:03:30	-79.9	119.2	29	-0.04	58.2
08/24/2002	18:54:18	79.6	-75.6	55	-0.04	58.2
09/03/2002	20:11:51	79.9	-92.2	47	0.03	57.9
09/13/2002	22:20:10	-79.8	54.9	6	-0.04	57.6
09/23/2002	23:37:32	-80.1	38.1	99	0.02	57.3
09/24/2002	00:28:18	79.7	-157.9	35	0.02	57.3
10/04/2002	01:45:36	79.9	-175.4	32	0.02	57.0
10/04/2002	02:36:25	-79.7	-10.2	61	0.02	57.0
10/14/2002	03:02:47	80.1	167.3	88	0.02	56.7
10/14/2002	03:53:37	-79.9	-27.7	9	0.02	56.7
10/24/2002	05:10:41	-80.0	-45.4	58	-0.05	-303.7
11/03/2002	06:27:40	-80.1	-63.7	88	-0.05	-304.0
11/03/2002	07:18:28	79.7	99.6	76	-0.05	-304.0
11/13/2002	08:35:21	79.8	81.4	47	0.02	-304.2
11/23/2002	09:01:19	-80.1	-101.5	94	-0.05	-304.6
11/23/2002	09:52:08	79.8	62.7	32	-0.05	-304.6
12/03/2002	10:18:01	-80.1	-121.0	70	0.02	-304.8

Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN
12/03/2002	11:08:50	79.9	43.7	37	0.02	-304.8
12/13/2002	11:34:38	-80.1	-140.4	45	0.02	-305.1
12/13/2002	12:25:27	79.8	24.6	47	0.02	-305.1
12/23/2002	12:51:11	-80.0	-160.5	7	-0.05	54.5
12/23/2002	13:41:59	79.8	4.7	80	-0.05	54.5

**Class I SNOs between NOAA-17 and NOAA-15**

09/09/2002	14:33:22	80.5	-0.8	90	-0.00	45.3
09/09/2002	15:23:59	-80.5	166.4	87	-0.00	45.3
09/09/2002	16:14:35	80.5	-25.6	65	-0.00	45.3
09/09/2002	17:05:11	-80.5	142.0	61	-0.00	45.3
09/09/2002	17:55:47	80.6	-50.0	39	-0.00	45.3
09/09/2002	18:46:23	-80.6	117.5	36	-0.00	45.3
09/09/2002	19:36:59	80.6	-74.5	14	-0.00	45.3
09/09/2002	19:37:00	80.6	-74.8	14	-0.00	45.3
09/09/2002	20:27:36	-80.6	92.7	11	-0.00	45.3
09/09/2002	21:18:12	80.7	-99.3	12	-0.00	45.3
09/09/2002	22:08:48	-80.7	68.3	14	-0.00	45.3
09/09/2002	22:59:24	80.7	-123.7	38	-0.00	45.3
09/09/2002	23:50:01	-80.7	43.5	40	-0.00	45.3
09/10/2002	00:40:37	80.8	-148.4	63	-0.00	45.3
09/10/2002	01:31:13	-80.8	19.2	66	-0.00	45.3
09/10/2002	02:21:49	80.8	-172.8	89	-0.00	45.3
09/10/2002	03:12:26	-80.8	-5.6	91	-0.00	45.3
12/21/2002	17:49:30	80.4	-49.8	82	-0.00	47.6
12/21/2002	18:40:02	-80.5	117.9	76	-0.00	47.6
12/21/2002	19:30:42	80.5	-74.4	58	-0.00	47.6
12/21/2002	20:21:15	-80.5	93.0	52	-0.00	47.6
12/21/2002	21:11:54	80.5	-99.0	33	-0.00	47.6
12/21/2002	22:02:27	-80.5	68.3	27	-0.00	47.6
12/21/2002	22:53:06	80.6	-123.7	8	-0.00	47.6
12/21/2002	23:43:38	-80.6	44.0	4	-0.00	47.6
12/22/2002	00:34:18	80.6	-148.3	16	-0.00	47.7
12/22/2002	01:24:50	-80.6	19.4	22	-0.00	47.7
12/22/2002	02:15:30	80.7	-172.9	41	-0.00	47.7
12/22/2002	03:06:03	-80.7	-5.6	46	-0.00	47.7
12/22/2002	03:56:42	80.7	162.5	66	-0.00	47.7
12/22/2002	04:47:14	-80.7	-29.8	71	-0.00	47.7
12/22/2002	05:37:54	80.7	137.9	90	-0.00	47.7
12/22/2002	06:28:26	-80.8	-54.4	95	-0.00	47.7
04/06/2003	07:08:11	-80.4	-69.7	85	-0.00	50.0
04/06/2003	07:58:51	80.4	97.6	79	-0.00	50.0
04/06/2003	08:49:23	-80.4	-94.5	62	-0.00	50.0
04/06/2003	09:40:03	80.4	72.9	55	-0.00	50.0
04/06/2003	10:30:35	-80.4	-119.2	38	-0.00	50.0
04/06/2003	11:21:14	80.5	48.5	31	-0.00	50.0
04/06/2003	12:11:47	-80.5	-144.0	14	-0.00	50.0
04/06/2003	13:02:26	80.5	23.8	7	-0.00	50.0
04/06/2003	13:52:58	-80.5	-168.4	10	-0.00	50.0
04/06/2003	14:43:38	80.5	-1.0	17	-0.00	50.0
04/06/2003	15:34:10	-80.6	166.9	34	-0.00	50.0
04/06/2003	16:24:50	80.6	-25.7	41	-0.00	50.0
04/06/2003	17:15:22	-80.6	142.2	58	-0.00	50.0
04/06/2003	18:06:01	80.6	-50.1	65	-0.00	50.0
04/06/2003	18:56:34	-80.7	117.5	81	-0.00	50.0
04/06/2003	19:47:13	80.7	-74.8	88	-0.00	50.0
07/22/2003	08:36:29	-80.3	-92.1	79	-0.00	52.3
07/22/2003	09:27:06	80.3	75.1	84	-0.00	52.3
07/22/2003	10:17:40	-80.3	-116.6	55	-0.00	52.3
07/22/2003	11:08:17	80.3	50.5	61	-0.00	52.3
07/22/2003	11:58:52	-80.4	-141.5	32	-0.00	52.3
07/22/2003	12:49:29	80.4	25.7	37	-0.00	52.3
07/22/2003	13:40:03	-80.4	-166.0	9	-0.00	52.3
07/22/2003	14:30:40	80.4	1.2	14	-0.00	52.3
07/22/2003	15:21:15	-80.5	169.2	15	-0.00	52.3
07/22/2003	16:11:52	80.5	-23.6	10	-0.00	52.3
07/22/2003	17:02:26	-80.5	144.7	39	-0.00	52.3
07/22/2003	17:53:03	80.5	-48.1	33	-0.00	52.3
07/22/2003	18:43:38	-80.6	119.9	62	-0.00	52.3
07/22/2003	19:34:15	80.5	-72.9	57	-0.00	52.3
07/22/2003	20:24:49	-80.6	95.4	85	-0.00	52.3
07/22/2003	21:15:26	80.6	-97.4	80	-0.00	52.3
11/07/2003	09:36:26	-80.1	-108.0	89	-0.07	-305.6
11/07/2003	10:26:59	80.1	59.4	97	-0.07	-305.6
11/07/2003	10:27:00	80.1	59.0	97	-0.07	-305.6
11/07/2003	11:17:37	-80.2	-132.6	66	-0.07	-305.6



Class I SNOs between NOAA-17 and NOAA-16													
Date	Time	Lat	Lon	$\delta$	$\epsilon$	$\Delta$ RAAN							
11/07/2003	12:08:10	80.2	34.7	74	-0.07	-305.6							
11/07/2003	12:58:48	-80.3	-157.2	43	-0.07	-305.6							
11/07/2003	13:49:22	80.2	9.8	51	-0.07	-305.6							
11/07/2003	14:39:59	-80.3	178.2	21	-0.07	-305.6							
11/07/2003	14:40:00	-80.3	177.9	21	-0.07	-305.6							
11/07/2003	15:30:33	80.3	-14.8	29	-0.07	-305.6							
11/07/2003	16:21:11	-80.4	153.3	3	-0.07	-305.6							
11/07/2003	17:11:44	80.4	-39.4	6	-0.07	-305.6							
11/07/2003	18:02:22	-80.4	128.7	25	-0.07	-305.6							
11/07/2003	18:52:56	80.4	-64.3	17	-0.07	-305.6							
11/07/2003	19:43:33	-80.5	104.1	48	-0.07	-305.6							
11/07/2003	20:34:07	80.4	-88.8	40	-0.07	-305.6							
11/07/2003	21:24:44	-80.5	79.5	71	-0.07	-305.6							
11/07/2003	22:15:18	80.5	-113.4	63	-0.07	-305.6							
11/07/2003	23:05:56	-80.5	54.6	94	-0.07	-305.6							
11/07/2003	23:56:29	80.5	-138.0	86	-0.07	-305.6							
09/03/2002	03:22:27	72.0	128.6	35	0.02	122.1							
09/11/2002	21:26:51	-72.9	39.3	83	0.02	122.2							
09/11/2002	22:17:39	72.3	-154.6	2	0.02	122.2							
09/11/2002	23:08:30	-71.7	11.6	77	0.02	122.2							
09/20/2002	17:12:44	72.5	-77.8	34	0.09	122.3							
09/20/2002	18:03:36	-72.0	88.4	42	0.09	122.3							
09/29/2002	12:07:45	72.7	-1.1	66	0.09	122.4							
09/29/2002	12:58:38	-72.2	165.1	8	0.09	122.4							
09/29/2002	13:49:24	71.5	-28.8	95	0.09	122.4							
10/08/2002	07:02:42	73.0	75.8	99	0.01	122.4							
10/08/2002	07:53:36	-72.4	-118.1	29	0.01	122.4							
10/08/2002	08:44:21	71.7	48.0	61	0.01	122.4							
10/17/2002	02:48:27	-72.7	-41.1	64	0.09	122.5							
10/17/2002	03:39:13	72.0	124.8	29	0.09	122.5							
10/17/2002	04:30:06	-71.4	-68.9	95	0.09	122.5							
10/25/2002	21:43:11	-73.0	35.8	97	0.02	-237.5							
10/25/2002	22:33:58	72.2	-158.3	5	0.02	-237.5							
10/25/2002	23:24:50	-71.7	8.0	63	0.02	-237.5							
11/03/2002	17:28:40	72.4	-81.5	35	0.02	-237.5							
11/03/2002	18:19:30	-71.9	84.8	31	0.02	-237.5							
11/12/2002	12:23:15	72.7	-4.6	66	0.09	-237.4							
11/12/2002	13:14:03	-72.2	161.7	2	0.09	-237.4							
11/12/2002	14:04:54	71.4	-32.4	93	0.09	-237.4							
11/21/2002	07:17:45	72.9	72.3	96	0.01	-237.4							
11/21/2002	08:08:31	-72.4	-121.4	27	0.01	-237.4							
11/21/2002	08:59:23	71.7	44.6	64	0.01	-237.4							
11/30/2002	03:02:55	-72.6	-44.6	52	-0.06	-237.4							
11/30/2002	03:53:48	71.9	121.4	37	-0.06	-237.4							
12/08/2002	21:57:16	-72.7	32.2	76	0.02	-237.3							
12/08/2002	22:48:09	72.1	-161.7	9	0.02	-237.3							
12/08/2002	23:38:54	-71.5	4.5	82	0.02	-237.3							
12/17/2002	17:42:25	72.2	-84.9	17	-0.05	-237.3							
12/17/2002	18:33:10	-71.7	81.4	59	-0.05	-237.3							
12/17/2002	16:51:32	-72.9	109.1	98	-0.06	-237.3							
12/26/2002	12:36:35	72.4	-8.0	39	0.02	-237.2							
12/26/2002	13:27:22	-71.8	158.1	38	0.02	-237.2							
01/04/2003	07:30:40	72.6	68.8	58	0.09	-237.1							
01/04/2003	08:21:29	-71.9	-125.1	20	0.09	-237.1							
01/13/2003	02:24:44	72.7	145.6	78	0.02	-237.2							

01/13/2003	03:15:34	-72.1	-48.2	2	0.02	-237.2	05/25/2003	02:03:49	-71.3	-30.6	95	0.08	123.1
01/13/2003	04:06:22	71.5	117.9	82	0.02	-237.2	06/02/2003	19:15:31	-72.6	73.9	70	0.03	123.0
01/21/2003	21:18:43	72.8	-137.5	95	0.09	-237.1	06/02/2003	20:06:16	71.9	-120.1	16	0.03	123.0
01/21/2003	22:09:35	-72.2	28.6	20	0.09	-237.1	06/02/2003	20:57:09	-71.3	46.2	88	0.03	123.0
01/21/2003	23:00:21	71.6	-165.3	65	0.09	-237.1	06/11/2003	14:08:47	-72.7	150.7	78	0.02	123.0
01/30/2003	17:03:32	-72.4	105.5	39	0.02	-237.1	06/11/2003	14:59:31	72.0	-43.2	11	0.02	123.0
01/30/2003	17:54:17	71.7	-88.4	48	0.02	-237.1	06/11/2003	15:50:25	-71.4	123.0	81	0.02	123.0
02/08/2003	11:57:27	-72.5	-177.6	59	-0.05	-237.2	06/20/2003	09:02:01	-72.7	-132.4	86	0.08	123.0
02/08/2003	12:48:12	71.8	-11.6	30	-0.05	-237.2	06/20/2003	09:52:45	72.1	33.7	5	0.08	123.0
02/17/2003	06:51:18	-72.7	-100.8	75	0.08	-237.0	06/20/2003	10:43:39	-71.5	-160.1	73	0.08	123.0
02/17/2003	07:42:03	72.0	65.2	15	0.08	-237.0	06/29/2003	03:55:12	-72.8	-55.5	91	0.01	123.0
02/17/2003	08:32:56	-71.4	-128.4	84	0.08	-237.0	06/29/2003	04:45:58	72.1	110.4	5	0.01	123.0
02/26/2003	01:45:05	-72.8	-23.8	92	0.08	123.0	06/29/2003	05:36:50	-71.5	-83.2	68	0.01	123.0
02/26/2003	02:35:52	72.1	142.0	3	0.08	123.0	07/07/2003	22:48:22	-72.8	21.3	92	-0.04	122.9
02/26/2003	03:26:44	-71.5	-51.6	67	0.08	123.0	07/07/2003	23:39:09	72.1	-172.8	3	-0.04	122.9
03/06/2003	21:29:39	72.2	-141.1	20	0.03	123.0	07/08/2003	00:29:59	-71.6	-6.4	66	0.09	123.0
03/06/2003	22:20:29	-71.7	25.3	48	0.03	123.0	07/08/2003	00:30:00	-71.5	-6.5	66	0.09	123.0
03/15/2003	16:23:22	72.3	-64.2	34	0.02	123.0	07/16/2003	17:41:28	-72.8	98.2	96	-0.05	122.9
03/15/2003	17:14:10	-71.8	102.2	34	0.02	123.0	07/16/2003	18:32:17	72.1	-95.9	7	-0.05	122.9
03/24/2003	11:17:02	72.5	12.7	50	0.02	123.0	07/16/2003	19:23:06	-71.6	70.5	63	-0.05	122.9
03/24/2003	12:07:49	-71.9	179.0	19	0.02	123.0	07/25/2003	12:34:33	-72.9	175.0	97	0.01	122.9
04/02/2003	06:10:40	72.6	89.6	67	-0.05	122.9	07/25/2003	13:25:24	72.1	-19.1	9	0.01	122.9
04/02/2003	07:01:26	-72.0	-104.2	7	-0.05	122.9	07/25/2003	14:16:11	-71.6	147.3	62	0.01	122.9
04/02/2003	07:52:18	71.3	61.9	92	-0.05	122.9	08/03/2003	07:27:37	-72.8	-108.2	96	0.09	123.0
04/11/2003	01:04:14	72.7	166.5	81	0.01	123.0	08/03/2003	08:18:29	72.2	57.7	9	0.09	123.0
04/11/2003	01:54:58	-72.1	-27.3	10	0.01	123.0	08/03/2003	09:09:15	-71.6	-136.0	63	0.09	123.0
04/11/2003	02:45:52	71.4	138.8	78	0.01	123.0	08/12/2003	02:20:39	-72.8	-31.5	95	-0.05	122.8
04/19/2003	19:57:45	72.8	-116.7	94	0.09	123.1	08/12/2003	03:11:32	72.1	134.5	11	-0.05	122.8
04/19/2003	20:48:30	-72.2	49.5	19	0.09	123.1	08/12/2003	04:02:16	-71.6	-59.1	64	-0.05	122.8
04/19/2003	21:39:23	71.5	-144.4	65	0.09	123.1	08/20/2003	21:13:39	-72.8	45.4	93	0.09	123.0
04/28/2003	15:42:00	-72.3	126.3	33	0.10	123.1	08/20/2003	22:04:32	72.2	-148.6	8	0.09	123.0
04/28/2003	15:41:59	-72.3	126.4	32	0.02	123.0	08/20/2003	22:55:17	-71.6	17.6	66	0.09	123.0
04/28/2003	16:32:51	71.7	-67.5	51	0.02	123.0	08/29/2003	16:06:38	-72.8	122.1	90	0.02	122.9
05/07/2003	10:35:25	-72.4	-156.7	43	0.09	123.1	08/29/2003	16:57:30	72.1	-71.9	6	0.02	122.9
05/07/2003	11:26:15	71.8	9.4	41	0.09	123.1	08/29/2003	17:48:15	-71.6	94.5	69	0.02	122.9
05/16/2003	05:28:49	-72.5	-79.8	53	0.02	123.0	09/07/2003	10:59:35	-72.8	-161.1	88	0.09	122.9
05/16/2003	06:19:38	71.8	86.2	31	0.02	123.0	09/07/2003	11:50:25	72.2	5.0	7	0.09	122.9
05/25/2003	00:22:11	-72.6	-2.9	63	0.08	123.1	09/07/2003	12:41:13	-71.5	171.2	70	0.09	122.9
05/25/2003	01:12:58	71.9	163.1	22	0.08	123.1	09/16/2003	05:52:30	-72.8	-84.2	87	0.01	122.8

09/16/2003	06:43:19	72.1	81.8	2	0.01	122.8
09/16/2003	07:34:08	-71.5	-112.0	72	0.01	122.8
09/25/2003	00:45:24	-72.8	-7.5	83	0.09	122.9
09/25/2003	01:36:11	72.1	158.5	4	0.09	122.9
09/25/2003	02:27:02	-71.5	-35.2	76	0.09	122.9
10/03/2003	19:38:15	-72.8	69.4	80	-0.05	122.7
10/03/2003	20:29:01	72.0	-124.7	8	-0.05	122.7
10/03/2003	21:19:53	-71.5	41.6	79	-0.05	122.7
10/12/2003	14:31:03	-72.8	146.2	77	-0.05	122.7
10/12/2003	15:21:48	72.0	-47.8	11	-0.05	122.7
10/12/2003	16:12:41	-71.5	118.5	82	-0.05	122.7
10/21/2003	09:23:49	-72.7	-137.0	74	-0.05	-237.4
10/21/2003	10:14:34	72.0	29.0	15	-0.05	-237.4
10/21/2003	11:05:27	-71.5	-164.7	85	-0.05	-237.4
10/30/2003	04:16:32	-72.7	-60.1	70	0.09	-237.2
10/30/2003	05:07:17	72.0	105.9	20	0.09	-237.2
10/30/2003	05:58:10	-71.4	-87.9	90	0.09	-237.2
11/07/2003	23:09:08	-72.6	16.6	60	0.02	-237.4
11/07/2003	23:59:54	72.0	-177.4	28	0.02	-237.4
11/08/2003	00:50:45	-71.4	-11.1	100	0.02	-237.4
11/16/2003	18:01:41	-72.6	93.4	50	0.03	-237.4
11/16/2003	18:52:30	71.9	-100.6	38	0.03	-237.4
11/25/2003	12:54:11	-72.5	170.2	39	0.09	-237.4
11/25/2003	13:45:01	71.8	-23.8	48	0.09	-237.4
12/04/2003	07:46:38	-72.4	-113.0	30	0.03	-237.5
12/04/2003	08:37:30	71.8	53.0	57	0.03	-237.5
12/13/2003	01:48:18	72.9	157.6	92	0.09	-237.5
12/13/2003	02:39:03	-72.3	-36.2	17	0.09	-237.5
12/13/2003	03:29:56	71.7	129.8	69	0.09	-237.5
12/21/2003	20:40:42	72.8	-125.7	79	-0.04	-237.6
12/21/2003	21:31:26	-72.3	40.5	4	-0.04	-237.6
12/21/2003	22:22:19	71.6	-153.4	82	-0.04	-237.6
12/30/2003	15:33:02	72.7	-48.9	64	0.02	-237.6
12/30/2003	16:23:47	-72.2	117.3	11	0.02	-237.6
12/30/2003	17:14:40	71.5	-76.6	97	0.02	-237.6

Appendix C. Class II SNOs for NOAA satellites  
(NOAA-6 to NOAA-17)

(see Appendix B for explanation)

Class II SNOs between NOAA-6 and NOAA-7

DATE	TIME	SAT	LAT/LON	DIST (KM)	
9/ 2/1981	23:29:	0	-79.30	355.90	185
9/28/1981	23:35:	0	-79.20	353.50	136
9/29/1981	1:16:30	-78.50	323.60	110	
10/ 7/1981	16:44:	0	-79.30	96.90	108
10/24/1981	23:39:	0	-79.40	354.30	120
10/25/1981	1:20:30	-78.70	323.90	125	
11/ 2/1981	16:47:30	-78.90	93.20	48	
11/20/1981	1:22:30	-78.60	322.90	81	
11/28/1981	16:48:30	-79.00	93.60	47	
12/ 7/1981	8:14:30	-78.80	221.10	43	
12/16/1981	1:22:	0	-78.40	321.90	177
1/ 2/1982	6:31:30	-79.60	252.20	111	
2/14/1982	13:19:30	-79.30	147.80	90	
2/23/1982	4:44:	0	-79.50	278.60	105
4/ 7/1982	11:27:30	-79.00	173.30	93	
4/16/1982	2:51:	0	-79.80	309.00	136
5/ 3/1982	11:20:	0	-79.30	177.20	57
5/12/1982	1: 2:30	-79.30	331.80	114	
5/20/1982	16:26:	0	-79.50	102.20	115
5/29/1982	7:49:30	-79.50	231.60	103	
6/ 6/1982	23:13:	0	-79.50	0.70	104
6/ 7/1982	0:54:30	-78.80	330.30	160	
6/24/1982	6: 0:	0	-78.90	254.20	128
7/28/1982	19:32:30	-79.00	51.60	80	
8/ 6/1982	9:14:	0	-79.40	209.60	77
8/23/1982	16: 0:	0	-79.20	105.90	17
9/ 1/1982	7:23:	0	-78.60	231.80	110
9/27/1982	3:49:30	-79.30	289.70	111	
10/14/1982	8:53:30	-78.90	210.40	95	
10/22/1982	22:34:	0	-79.90	13.10	165
10/23/1982	0:15:30	-79.20	342.20	116	
11/ 9/1982	5:18:30	-79.30	267.00	23	
11/17/1982	20:40:30	-79.20	35.40	120	
12/ 5/1982	1:43:	0	-79.20	319.80	38
12/13/1982	15:23:	0	-79.80	119.40	76
12/30/1982	20:24:30	-80.00	46.20	120	
12/31/1982	1:30:	0	-79.40	324.60	184
1/17/1983	1:26:	0	-79.90	329.20	112
2/ 3/1983	8: 9:	0	-78.60	219.30	149
2/20/1983	11:28:	0	-80.20	181.60	151
3/ 1/1983	2:49:30	-79.30	303.20	37	
3/ 9/1983	16:29:	0	-79.80	102.60	110
3/18/1983	7:50:	0	-79.60	230.20	54
3/26/1983	21:29:30	-80.00	28.60	92	
4/ 4/1983	12:50:30	-79.60	155.30	84	
4/21/1983	17:51:	0	-79.30	77.50	100
4/30/1983	7:30:30	-79.30	232.90	40	
5/ 8/1983	21: 9:30	-80.20	36.20	137	
6/20/1983	20:49:	0	-79.10	31.40	93
6/29/1983	10:28:	0	-79.40	188.90	89
7/ 8/1983	0: 7:	0	-79.70	345.90	129
7/16/1983	15:27:30	-79.00	111.00	126	
8/ 2/1983	18:45:	0	-80.10	69.70	88
8/19/1983	22: 3:	0	-79.80	17.80	68
8/28/1983	11:42:	0	-79.60	170.90	138
9/ 6/1983	1:20:30	-80.20	332.20	135	
9/23/1983	6:19:30	-79.80	253.30	119	
10/ 1/1983	19:58:30	-79.40	44.80	87	
11/ 5/1983	2:33:	0	-79.70	309.00	38
11/13/1983	16:11:30	-79.80	105.10	44	
11/22/1983	5:50:	0	-79.90	260.80	46
12/ 9/1983	9: 7:	0	-79.80	210.40	29
1/21/1984	5:19:	0	-79.70	266.10	79
1/29/1984	18:57:30	-79.30	58.70	115	
2/15/1984	22:14:	0	-79.50	10.60	113
2/24/1984	11:52:	0	-80.00	169.90	119
3/ 3/1984	23:49:	0	-80.10	351.50	194
3/ 4/1984	1:30:30	-79.30	320.10	131	
3/12/1984	15: 8:30	-79.60	117.70	107	
3/21/1984	4:46:30	-79.80	274.50	97	
3/29/1984	18:24:30	-79.90	71.10	97	

4/15/1984	21:40:30	-79.80	20.60	75
5/ 2/1984	23:14:30	-80.90	9.50	261
5/ 3/1984	0:56: 0	-80.30	337.00	67
5/20/1984	4:12: 0	-79.70	281.70	87
5/28/1984	17:49:30	-80.20	82.10	29
6/ 6/1984	7:27: 0	-80.60	241.90	84
6/14/1984	21: 5: 0	-80.10	31.50	68
7/ 2/1984	0:20: 0	-80.50	347.60	75
7/10/1984	13:57:30	-80.70	144.70	91
7/19/1984	3:35: 0	-80.70	301.10	100
7/27/1984	17:12:30	-80.70	96.80	100
8/13/1984	20:27:30	-80.70	46.70	86
8/22/1984	10: 5: 0	-80.60	201.10	80
8/30/1984	23:42:30	-80.40	355.20	85
8/31/1984	1:24: 0	-79.80	323.10	209
9/ 8/1984	13:20: 0	-80.30	149.10	110
9/17/1984	2:57: 0	-80.90	312.70	141
9/25/1984	16:34:30	-80.70	105.70	136
10/ 4/1984	7:53:30	-79.90	226.60	143
10/12/1984	21:31: 0	-79.60	19.40	151
10/21/1984	11: 8: 0	-80.20	180.60	131
10/29/1984	23: 4: 0	-80.50	4.50	173
10/30/1984	4: 7:30	-80.30	286.30	62
11/ 7/1984	16: 3:30	-80.50	109.80	92
12/20/1984	10:28:30	-80.30	189.90	68
1/ 6/1985	13:42:30	-80.70	146.40	94
1/15/1985	5: 1: 0	-80.30	271.90	125
2/ 1/1985	8:15: 0	-80.70	227.80	56
2/27/1985	2:47:30	-80.50	307.20	28
3/ 7/1985	16:24:30	-80.60	104.10	100
4/ 2/1985	10:56:30	-80.90	189.30	59
5/15/1985	10:24: 0	-80.10	187.60	144
5/23/1985	22:19: 0	-81.20	24.40	233
5/24/1985	0: 0:30	-80.80	351.00	83
6/10/1985	3:14:30	-80.40	297.40	84
7/ 5/1985	21:46: 0	-80.40	19.80	103
7/14/1985	11:22:30	-80.80	180.50	84
7/31/1985	14:36: 0	-80.70	130.20	28
8/ 9/1985	4:12:30	-80.90	289.60	43
8/26/1985	7:26: 0	-80.70	236.90	27
9/12/1985	10:39: 0	-81.00	194.20	70
9/21/1985	0:15:30	-81.20	352.70	93
10/16/1985	17: 5:30	-81.00	95.40	100
11/11/1985	9:55: 0	-81.10	205.20	69
11/20/1985	1:13: 0	-80.60	327.70	282
12/ 7/1985	2:44:30	-81.00	310.90	35
12/24/1985	5:57:30	-80.80	259.10	104
1/ 1/1986	19:34: 0	-80.70	52.80	146
1/10/1986	7:29: 0	-81.00	239.60	114
1/27/1986	10:42: 0	-80.80	186.30	56
2/13/1986	13:54:30	-81.10	142.90	58
2/22/1986	3:31: 0	-80.80	294.90	109
3/ 2/1986	15:26: 0	-81.10	120.40	112
3/19/1986	18:38:30	-81.20	73.60	41
4/ 5/1986	20:10: 0	-81.00	47.70	126
4/14/1986	9:46:30	-80.60	197.60	54
4/22/1986	23:22:30	-80.90	357.60	53
5/ 1/1986	12:59: 0	-80.50	147.00	148
5/10/1986	0:53:30	-81.20	339.80	77
5/18/1986	14:30: 0	-80.80	128.20	17
5/27/1986	4: 6: 0	-81.00	287.10	114
6/ 4/1986	16: 1: 0	-81.00	108.30	97
6/13/1986	5:37: 0	-81.10	266.50	25
6/21/1986	19:13:30	-80.60	53.50	126
6/30/1986	7: 8: 0	-81.10	243.90	50
8/20/1986	11:40:30	-81.10	174.00	97
8/28/1986	23:35: 0	-81.40	1.80	247
8/29/1986	1:16:30	-81.00	327.90	70
9/ 6/1986	13:11:30	-80.70	144.40	78
9/15/1986	2:47:30	-80.50	298.10	85
9/23/1986	14:42: 0	-80.90	124.40	65
10/10/1986	16:12:30	-81.10	104.30	51
10/19/1986	4: 7:30	-80.70	279.80	76
11/22/1986	7: 8:30	-80.60	233.00	38
12/17/1986	20:33:30	-80.50	29.50	29
9/11/1981	15:48: 0	79.20	290.70	110
9/28/1981	22:44: 0	79.80	191.60	264
10/ 7/1981	15:53:30	78.90	286.80	117

10/24/1981	22:48: 0	79.90	190.80	245
11/ 2/1981	15:56:30	79.50	290.30	97
11/11/1981	9: 5: 0	78.60	27.40	104
11/19/1981	22:50: 0	79.30	185.40	215
12/ 7/1981	7:24: 0	78.80	53.90	96
12/15/1981	22:50: 0	79.10	184.00	139
12/16/1981	0:31:30	78.40	154.10	102
1/11/1982	0:29:30	78.10	153.30	214
1/28/1982	5:38:30	79.20	82.70	122
2/14/1982	14:10: 0	79.10	313.80	58
3/21/1982	3:48:30	79.10	108.90	127
3/29/1982	20:54: 0	78.90	211.30	110
4/ 7/1982	12:18: 0	79.20	342.60	113
4/16/1982	3:42: 0	79.10	110.60	77
5/29/1982	8:40:30	78.60	32.60	101
6/ 6/1982	22:22: 0	80.20	199.30	245
6/24/1982	6:50:30	78.80	61.50	60
7/11/1982	11:55:30	79.40	349.30	118
8/ 6/1982	10: 5: 0	78.80	12.50	69
8/23/1982	15: 9:30	79.10	298.30	143
9/ 1/1982	6:32: 0	79.60	71.60	75
9/18/1982	11:36: 0	80.00	358.30	144
9/27/1982	2:59: 0	79.10	120.60	78
10/14/1982	9:44: 0	78.90	17.70	126
10/22/1982	23:25: 0	78.80	172.40	116
10/23/1982	1: 6:30	78.00	142.40	254
11/ 9/1982	4:27:30	80.00	105.70	140
11/17/1982	19:50: 0	78.90	226.20	99
12/ 5/1982	0:52: 0	79.80	157.50	85
12/13/1982	16:14: 0	79.30	282.80	18
12/31/1982	0:39:30	79.40	156.80	32
1/ 8/1983	10:55:30	79.60	4.20	92
1/17/1983	2:17: 0	79.20	131.40	38
1/25/1983	15:56:30	80.10	293.30	128
2/11/1983	20:57:30	80.10	218.80	148
2/20/1983	12:19: 0	79.20	340.60	43
3/ 1/1983	1:58:30	79.90	141.40	124
3/18/1983	6:59:30	79.40	61.20	140
3/26/1983	22:20:30	79.10	189.20	68
4/ 4/1983	12: 0: 0	79.50	347.30	85
4/21/1983	17: 0:30	79.30	270.00	86
4/30/1983	6:39:30	80.30	74.00	145
5/ 8/1983	22: 0:30	79.60	197.10	39
6/20/1983	19:58: 0	79.80	229.60	115
6/29/1983	11:18:30	79.40	356.00	88
7/ 7/1983	23:16: 0	80.30	184.80	252
7/ 8/1983	0:57:30	79.70	153.10	24
7/16/1983	14:36:30	79.80	309.60	33
8/ 2/1983	17:54:30	79.90	261.30	135
8/11/1983	9:15: 0	79.20	24.90	112
8/19/1983	22:54: 0	79.10	179.20	114
8/28/1983	12:32:30	79.80	340.50	61
9/ 6/1983	2:11:30	79.50	133.10	40
9/23/1983	5:29: 0	79.70	84.90	36
10/ 1/1983	19: 7:30	80.10	244.20	64
11/ 5/1983	1:42: 0	80.30	147.40	109
11/13/1983	15:20:30	80.50	304.60	137
11/22/1983	4:59: 0	80.60	100.90	151
11/30/1983	18:38: 0	79.70	247.30	150
12/ 9/1983	8:16: 0	80.50	51.20	140
1/21/1984	4:28:30	79.60	98.00	102
1/29/1984	18: 6:30	80.20	258.40	35
2/15/1984	21:23: 0	80.20	209.50	35
2/24/1984	11: 1:30	79.70	360.00	77
3/21/1984	3:55:30	80.50	114.20	83
3/29/1984	17:34: 0	79.80	262.40	111
4/15/1984	20:49:30	80.60	222.10	114
4/24/1984	10:27:30	80.50	15.80	100
5/ 3/1984	0: 5:30	80.30	169.40	115
5/20/1984	3:21: 0	80.50	122.90	140
5/28/1984	18:40:30	79.40	242.10	156
6/ 6/1984	8:18: 0	79.80	40.60	135
6/14/1984	21:55:30	80.10	198.90	130
6/23/1984	11:33: 0	80.30	357.00	139
7/ 1/1984	23:29:30	80.30	177.40	210
7/ 2/1984	1:11: 0	79.60	145.60	116
7/10/1984	14:48:30	79.80	302.50	94
7/19/1984	4:26: 0	79.90	99.10	75

7/27/1984	18: 3:30	80.00	255.20	69
8/13/1984	21:18:30	80.00	206.50	60
8/22/1984	10:56: 0	79.90	1.40	67
8/30/1984	22:52: 0	80.50	187.80	258
8/31/1984	0:33:30	79.80	155.70	86
9/17/1984	3:48: 0	80.30	112.10	50
9/25/1984	17:25:30	80.10	265.00	49
10/ 4/1984	7: 2:30	80.60	67.10	80
10/12/1984	20:40: 0	80.30	218.80	24
10/21/1984	10:17:30	80.00	10.80	66
10/29/1984	23:54:30	80.50	171.50	22
10/30/1984	3:16:30	80.80	125.90	94
11/ 7/1984	13:32: 0	80.10	322.80	59
12/20/1984	9:37:30	81.00	32.30	132
1/ 6/1985	14:33:30	80.10	306.70	68
1/15/1985	4:10:30	80.30	104.30	50
2/ 1/1985	9: 6: 0	79.90	26.80	124
2/27/1985	1:56:30	81.00	147.30	148
3/ 7/1985	17:15: 0	80.60	271.00	90
3/24/1985	20:29: 0	80.70	224.00	113
4/ 2/1985	11:47:30	80.20	347.70	86
4/28/1985	6:19:30	80.40	71.40	133
5/15/1985	9:33: 0	80.90	29.90	49
5/23/1985	23:10: 0	80.70	183.20	64
5/24/1985	0:51:30	80.10	150.60	230
6/ 1/1985	12:47: 0	80.50	335.90	115
6/10/1985	4: 5: 0	80.40	105.40	145
7/ 5/1985	20:55: 0	81.00	219.60	47
7/14/1985	10:32: 0	80.60	10.20	69
7/31/1985	13:45: 0	81.20	331.60	152
8/ 9/1985	3:22: 0	80.90	120.90	176
8/17/1985	18:40: 0	80.60	247.60	106
8/26/1985	8:16:30	80.80	46.70	101
9/12/1985	11:30: 0	80.60	354.00	73
9/20/1985	23:25: 0	81.20	185.10	233
9/21/1985	1: 6:30	80.70	151.60	58
10/16/1985	17:56:30	80.20	253.20	111
10/25/1985	7:33: 0	80.30	49.60	120
11/ 2/1985	21: 9:30	80.40	206.00	125
11/11/1985	10:46: 0	80.40	1.90	125
11/19/1985	22:41: 0	81.00	190.90	173
11/20/1985	0:22:30	80.40	157.90	141
11/28/1985	12:17:30	80.90	346.50	143
12/ 7/1985	1:54: 0	80.90	141.80	144
12/15/1985	15:30:30	80.90	296.90	132
12/24/1985	5: 7: 0	80.80	91.60	102
1/10/1986	8:20: 0	80.50	39.30	43
1/27/1986	11:32:30	80.90	355.60	116
2/ 4/1986	23:27:30	81.10	181.60	120
2/ 5/1986	1: 9: 0	80.70	148.20	184
2/13/1986	13: 4: 0	80.90	333.60	55
3/11/1986	5:53: 0	80.80	78.70	135
3/19/1986	17:48: 0	81.00	263.30	105
4/ 5/1986	21: 0:30	81.10	215.80	28
4/14/1986	10:37: 0	80.70	6.20	87
4/22/1986	22:32: 0	80.90	189.70	151
4/23/1986	0:13:30	80.30	156.80	169
5/ 1/1986	12: 8: 0	81.10	350.00	66
5/10/1986	1:44:30	80.80	139.00	36
5/18/1986	15:20:30	81.00	298.10	145
5/27/1986	3:15:30	81.00	119.40	53
6/ 4/1986	16:51:30	81.10	277.30	75
6/13/1986	4:46:30	81.00	97.50	117
6/30/1986	7:58:30	81.10	50.90	27
8/11/1986	22:55: 0	81.20	188.50	132
8/12/1986	0:36:30	80.80	154.90	189
8/20/1986	12:31:30	80.50	332.60	31
8/29/1986	0:26: 0	81.00	160.40	136
9/ 6/1986	14: 2: 0	80.90	314.30	4
9/15/1986	1:56:30	81.20	141.40	117
9/23/1986	15:32:30	81.00	294.20	61
10/10/1986	17: 3:30	80.40	262.50	115
10/19/1986	4:58: 0	80.70	87.70	22
11/22/1986	7:59: 0	81.10	47.90	53
12/17/1986	21:24: 0	80.60	198.20	6
12/26/1986	9:18:30	80.70	21.30	118

Class II SNOs between NOAA-7 and NOAA-8

DATE	TIME	SAT	LAT/LON	DIST (KM)
7/27/1983	8:56:30	79.60	34.50	16
8/ 6/1983	23:52:30	79.40	172.30	99
8/ 7/1983	0:43:30	-79.40	339.40	61
8/17/1983	15:39:30	-79.40	116.20	48
8/17/1983	16:30:30	79.30	284.00	90
8/28/1983	7:26:30	79.30	60.40	56
9/29/1983	5:56:30	79.70	79.90	50
10/ 9/1983	20:52:30	79.90	213.40	71
10/ 9/1983	21:43:00	-79.10	28.80	99
11/21/1983	11: 8:30	-80.00	179.90	79
11/21/1983	11:59:00	79.20	354.30	76
12/12/1983	18:41:30	-79.60	70.50	37
12/12/1983	19:32:30	79.70	237.50	72
1/13/1984	18: 1:00	79.30	263.90	69
2/ 4/1984	1:34:00	79.60	148.60	30
2/ 4/1984	7:28:30	-79.80	238.40	24
2/25/1984	9: 6:30	79.40	38.10	73
3/ 7/1984	0:53:00	-79.80	338.10	46
3/28/1984	9:16:00	79.60	34.50	65
3/28/1984	10: 7:00	-79.50	202.40	92
4/18/1984	17:39:00	-79.80	87.10	52
4/18/1984	18:30:00	79.80	253.90	53
4/29/1984	10:16:00	-80.10	194.40	73
5/31/1984	12: 6:00	-80.00	168.60	47
6/21/1984	21:19:00	-79.90	33.10	65
7/ 2/1984	13:55:30	-79.90	144.00	89
7/ 2/1984	14:46:30	80.00	310.20	85
7/23/1984	23:59:30	80.20	169.00	81
8/14/1984	10: 3:00	-79.90	202.80	20
8/25/1984	2:39:30	-80.30	309.30	79
8/25/1984	3:30:00	79.50	125.40	81
9/15/1984	13:33:30	-79.70	153.30	52
10/28/1984	10:31:00	79.70	19.50	58
10/28/1984	11:22:00	-79.80	186.50	88
11/ 8/1984	3:58:30	-80.30	290.10	86
11/18/1984	20:34:30	-80.20	43.00	98
11/18/1984	21:25:00	79.60	217.60	80

11/29/1984	14: 1:30	80.30	320.50	92
11/29/1984	14:52:30	-80.20	129.00	85
12/10/1984	7:28:30	-80.20	240.80	49
12/10/1984	8:19:30	80.30	46.40	95
12/21/1984	1:46:00	-80.20	326.40	81
12/21/1984	2:37:00	80.30	132.70	57
12/31/1984	20: 3:30	-80.00	54.80	74
12/31/1984	20:54:30	80.10	221.40	16
1/11/1985	14:21:00	-79.90	141.90	94
1/11/1985	15:12:00	79.90	309.70	48
2/ 2/1985	3:47:00	79.70	123.30	82
2/12/1985	22: 4:30	79.70	209.50	89
3/ 6/1985	10:39:30	79.90	18.60	53
3/ 6/1985	11:30:30	-79.90	185.70	79
3/17/1985	4:57:00	80.00	104.00	59
3/17/1985	5:48:00	-80.00	271.30	70
3/27/1985	23:14:30	80.10	187.80	79
3/28/1985	0: 5:30	-80.10	355.70	47
4/18/1985	12:40:30	-80.30	164.10	42
4/29/1985	6:58:00	-80.50	246.40	81
4/29/1985	7:48:30	80.00	62.40	60
5/10/1985	1:15:00	-80.10	339.50	83
5/10/1985	2: 6:00	80.10	146.60	33
5/20/1985	20:23:30	80.30	229.40	18
6/11/1985	8:58:00	80.10	43.90	77
6/11/1985	9:49:00	-80.30	208.90	30
7/13/1985	16:41:00	-80.40	104.70	81
8/ 4/1985	6: 6:30	80.50	82.10	53
8/25/1985	19:32:00	-80.60	60.70	78
9/27/1985	2:23:30	-80.50	319.30	91
9/27/1985	3:14:30	80.50	127.50	40
10/ 7/1985	21:31:30	80.30	217.20	36
11/ 9/1985	4:23:00	80.30	114.90	95
11/ 9/1985	5:14:00	-80.40	280.50	19
11/19/1985	22:40:30	80.70	193.60	98
11/19/1985	23:31:30	-80.70	1.00	61



**Class II SNOs between NOAA-8 and NOAA-9**

DATE	TIME	SAT	LAT/LON	DIST (KM)
1/ 2/1985	3:18:30	78.40	113.00	61
3/ 6/1985	8:59: 0	78.90	30.60	55
4/29/1985	13:43:30	-79.20	141.80	92
4/29/1985	14:34:30	78.60	305.00	87
7/10/1985	20:19:30	78.90	220.00	13
7/10/1985	21:10:30	-78.30	24.10	95
8/15/1985	23:12: 0	-78.80	356.10	92
8/25/1985	0: 7:30	79.40	166.20	89
8/25/1985	0:58:30	-78.40	327.60	81
9/ 3/1985	1: 3:30	-78.60	327.30	78
9/21/1985	2:55: 0	-78.50	298.60	81
10/18/1985	5:42: 0	78.70	78.20	79
10/27/1985	5:47: 0	78.70	77.00	65
11/ 5/1985	6:42:30	-79.30	246.90	66
11/14/1985	7:38: 0	79.40	53.50	90

**Class II SNOs between NOAA-9 and NOAA-10**

DATE	TIME	SAT	LAT/LON	DIST (KM)
10/ 9/1986	11:53: 0	-79.80	172.70	97
10/18/1986	13:39:30	-79.50	143.20	80
10/18/1986	14:30:30	78.90	306.50	72
10/27/1986	16:16:30	79.60	284.60	43
11/14/1986	19:49: 0	79.70	232.80	66
11/14/1986	20:40: 0	-79.00	34.40	94
11/24/1986	0:58: 0	79.30	152.80	22
12/ 3/1986	0:12:30	-79.10	342.50	73
12/ 3/1986	1: 3: 0	79.30	151.00	44
3/31/1987	7:39:30	-79.20	231.90	58
4/ 9/1987	10:16: 0	79.70	16.80	62
4/27/1987	14:39: 0	-79.60	130.40	69
5/ 6/1987	17:15:30	79.90	274.00	79
5/ 6/1987	18: 6:30	-79.40	76.70	85
6/ 3/1987	1: 6: 0	-79.50	332.20	35
6/12/1987	3:42:30	79.90	117.40	79
6/30/1987	8:56: 0	79.70	37.10	34
7/18/1987	14: 9:30	79.40	316.00	35
7/27/1987	16:46: 0	-79.70	99.30	27

8/14/1987	21:59:30	-79.40	18.60	45
8/24/1987	1:26:30	-79.90	331.70	80
9/ 2/1987	5:44:30	79.60	83.90	76
9/11/1987	16:47:30	-79.80	100.10	27
9/12/1987	4:36:30	-79.80	282.60	36
9/20/1987	8:26: 0	-79.30	221.30	88
9/20/1987	16: 1:30	79.70	290.80	39
9/29/1987	10:11:30	-80.10	202.10	85
9/29/1987	11: 2:30	79.50	3.40	72
10/ 8/1987	13:39: 0	-79.50	144.80	65
12/ 2/1987	5:18: 0	-79.70	272.00	57
12/ 2/1987	6: 8:30	79.90	81.30	40
12/29/1987	14:48:30	79.70	309.50	29
1/25/1988	21:47: 0	79.80	205.20	55
1/25/1988	22:37:30	-80.10	15.40	51
2/ 3/1988	19:19:30	-79.70	61.70	49
2/ 3/1988	23:32:30	80.10	182.40	93
2/22/1988	7:17: 0	-80.10	246.10	79
3/ 2/1988	9:53:30	79.90	24.60	10
3/29/1988	17:42:30	-79.50	83.50	83
4/ 7/1988	20:18:30	79.80	227.40	31
4/16/1988	22:54:30	-80.20	12.40	77
4/26/1988	2:21:30	-79.90	317.20	10
4/26/1988	3:12: 0	80.00	125.40	12
5/ 5/1988	4:57:30	79.90	98.10	24
5/ 5/1988	5:48: 0	-80.30	269.70	63
5/23/1988	11: 0:30	-79.60	185.00	69
5/23/1988	11:51: 0	79.80	353.80	45
6/10/1988	17:53:30	-80.10	86.20	40
6/19/1988	19:39: 0	-79.70	55.90	77
6/19/1988	20:29:30	80.10	226.90	39
7/ 8/1988	1:41:30	79.70	145.60	59
7/ 8/1988	2:32: 0	-79.80	314.10	38
7/17/1988	4:17: 0	-80.20	291.40	50
7/17/1988	5: 7:30	80.50	102.50	92
7/26/1988	7:43:30	-80.10	239.20	49
8/ 4/1988	10:19:30	79.70	16.40	55
8/ 4/1988	11:10: 0	-80.00	186.60	19
8/13/1988	13:45:30	80.40	331.20	56

8/22/1988	16:21:30	-80.00	107.90	44
8/22/1988	17:12:00	80.10	276.20	65
8/31/1988	18:57:00	80.10	250.40	12
8/31/1988	19:47:30	-80.50	62.20	82
9/19/1988	0:59:00	-79.90	338.20	51
9/19/1988	1:49:30	80.10	146.80	48
9/28/1988	3:34:30	79.90	118.80	56
9/28/1988	4:25:00	-80.20	289.30	12
10/16/1988	9:36:00	-79.80	207.80	59
10/25/1988	12:11:00	80.40	354.80	42
10/25/1988	13:13:00	-80.40	163.00	53
11/3/1988	15:37:00	80.10	299.80	20
11/3/1988	16:27:30	-80.20	108.20	7
11/21/1988	21:37:30	-80.50	34.10	60
11/21/1988	22:28:30	79.90	195.70	45
12/10/1988	3:38:00	80.50	124.20	80
12/10/1988	4:29:00	-79.90	285.40	51
12/19/1988	7:33:00	80.40	71.60	32

**Class II SNOs between NOAA-10 and NOAA-11**

DATE	TIME	SAT	LAT/LON	DIST (KM)
3/28/1989	15:54:00	77.40	277.60	98
4/5/1989	23:02:00	77.70	172.00	84
4/14/1989	7:51:30	77.90	40.60	12
4/22/1989	16:41:00	77.70	266.90	79
5/9/1989	8:38:00	78.20	30.30	31
5/17/1989	15:46:00	77.80	281.30	87
5/17/1989	16:36:30	-78.40	91.50	76
5/26/1989	0:35:00	77.70	148.60	68
5/26/1989	1:25:30	-78.30	318.80	48
9/11/1989	11:26:30	-78.00	166.50	84
10/31/1989	11:06:00	-78.70	174.90	97
12/3/1989	18:49:30	-78.70	59.30	90
12/12/1989	4:26:30	78.10	91.50	88
12/20/1989	11:31:00	78.40	347.00	67
12/20/1989	12:22:00	-77.80	151.20	86
1/22/1990	20:13:00	-78.80	41.50	84
1/22/1990	20:52:30	78.10	204.80	59

1/31/1990	4:47:00	-78.90	270.30	77
1/31/1990	5:38:00	77.90	72.10	84
2/8/1990	13:32:30	-78.30	135.30	29
3/13/1990	22:00:30	78.80	191.10	52
3/13/1990	22:51:30	-77.90	353.50	94
5/19/1990	15:42:00	-79.10	106.90	82
5/19/1990	16:33:00	78.40	269.90	47
6/5/1990	9:10:00	-78.50	201.10	32
6/13/1990	17:03:00	78.50	262.80	51
7/17/1990	1:25:00	-78.90	319.60	58
7/17/1990	2:16:00	78.20	123.00	80
9/5/1990	2:22:00	-78.70	303.90	54
9/13/1990	10:14:00	79.00	7.20	24
9/13/1990	11:05:00	-78.30	170.80	92
10/8/1990	10:41:00	79.10	1.00	38
10/25/1990	3:15:30	-79.20	292.90	48
10/25/1990	4:06:30	78.50	95.70	82
11/10/1990	20:40:30	-78.50	27.40	99
12/30/1990	22:21:00	79.00	184.70	9
1/16/1991	14:54:00	-79.30	117.90	63
2/27/1991	10:21:30	-78.90	183.30	60
4/18/1991	13:34:00	79.30	317.10	85
4/18/1991	14:24:30	-79.50	126.00	85
5/22/1991	1:03:00	-79.60	326.90	89
6/7/1991	17:31:00	79.60	259.30	74
6/7/1991	18:22:00	-79.00	62.20	69
8/4/1991	5:24:30	-79.50	259.50	77
8/13/1991	14:42:30	79.10	296.90	77
9/7/1991	14:56:00	79.90	299.70	65

**Class II SNOs between NOAA-11 and NOAA-12**

DATE	TIME	SAT	LAT/LON	DIST (KM)
5/27/1991	20:29:30	-79.20	34.60	58
5/27/1991	21:20:30	79.20	201.30	78
6/7/1991	17:30:30	78.70	263.10	67
8/11/1991	15:05:30	79.00	298.50	65
1/20/1992	6:59:30	79.20	62.30	18
6/19/1992	0:19:00	79.60	162.90	20
6/19/1992	1:09:30	-79.30	332.70	41

DATE	TIME	SAT	LAT/LON	DIST (KM)	NOAA-14
7/ 9/1992	22:41:	0	-79.60	7.40	97
8/11/1992	3:14:	0	79.20	123.80	96
10/25/1992	0:44:30	-79.60	339.10		97
11/15/1992	10: 3:30	-79.30	203.10		79
5/26/1993	19:11:30	80.20	242.20		92
10/23/1993	5:17:	0	80.40	92.00	88
10/23/1993	6: 8:	0	-80.40	260.40	28
12/15/1993	13: 2:	0	80.50	335.80	55
12/15/1993	13:53:	0	-80.50	143.40	97
12/26/1993	4:48:30	-80.30	282.90		88
12/26/1993	5:39:30	80.30	90.00		83
2/ 6/1994	19:55:	0	-80.50	54.90	47
2/ 6/1994	20:46:	0	80.50	222.90	96
3/21/1994	11: 1:	0	-80.60	187.40	80
5/ 3/1994	1:15:	0	80.30	160.80	70
5/13/1994	16:10:30	80.60	293.00		5
5/13/1994	17: 1:30	-80.60	98.80		88
6/14/1994	13:47:	0	-80.60	150.10	83
11/ 5/1995	9:44:	0	-80.80	208.50	21
6/17/1996	1:15:30	-78.30	310.10		286
6/25/1996	23:37:	0	-80.10	347.20	230
10/21/1996	22:18:30	-80.30	7.20		263
2/17/1997	0:20:	0	-79.00	324.20	228
2/25/1997	22:41:	0	-80.50	2.10	285
4/30/1997	12:32:30	-80.30	150.80		126
5/ 9/1997	14:17:	0	-79.80	119.80	119
5/18/1997	16: 1:	0	-80.20	97.00	126
5/27/1997	19:27:	0	-79.10	36.20	143
6/ 5/1997	21:11:	0	-79.30	11.70	136
6/14/1997	21:13:30	-79.90	16.00		121
6/23/1997	22:57:30	-80.00	350.50		102
6/24/1997	0:39:	0	-79.60	321.40	162
9/13/1997	14:33:	0	-80.00	114.80	136
9/22/1997	14:35:30	-80.10	115.00		116
11/ 7/1997	0:56:	0	-79.10	311.50	297
11/15/1997	23:16:30	-80.40	347.00		219
12/13/1997	6: 9:	0	-79.90	238.40	109
12/22/1997	7:52:30	-80.10	214.10		139
12/31/1997	7:54:30	-80.60	219.20		122
1/ 9/1998	9:38:	0	-80.70	194.60	126
3/23/1998	1: 7:30	-79.50	308.90		291
3/31/1998	23:27:30	-80.80	348.20		249
8/ 5/1998	23:31:30	-80.70	342.70		234
12/10/1998	23:28:30	-81.00	346.70		226
12/28/1994	11:53:	0	78.70	339.80	67
2/ 3/1995	0: 2:30	77.10	149.20		202
4/ 7/1995	17:29:	0	77.90	250.10	108
5/ 4/1995	22:46:30	79.00	177.00		194
8/ 4/1995	0:51:30	78.40	140.90		231
8/22/1995	4:23:	0	77.90	85.10	132
10/ 6/1995	14:52:	0	78.40	289.80	101
11/ 2/1995	20: 8:30	78.40	210.50		125
11/20/1995	23:39:	0	79.20	162.60	134
11/21/1995	1:20:30	78.70	134.20		115
1/ 5/1996	10: 7:	0	79.10	4.40	103
1/14/1996	13:34:	0	78.10	306.50	134
2/28/1996	22:19:30	79.80	185.20		144
2/29/1996	0: 1:30	78.20	149.40		142

**Class II SNOs between NOAA-12 and NOAA-14**

DATE	TIME	SAT	LAT/LON	DIST (KM)	
2/ 3/1995	0:53:	0	-77.60	318.50	262
3/29/1995	13:10:30	-79.00	141.10		124
4/16/1995	18:24:	0	-78.80	61.60	101
5/ 5/1995	1:19:	0	-77.90	312.70	143
6/ 1/1995	8:18:	0	-78.00	208.20	102
6/28/1995	13:35:	0	-79.10	134.70	125
8/ 3/1995	22:19:	0	-79.60	7.00	176
9/ 9/1995	7: 3:	0	-79.40	233.70	134
10/24/1995	17:32:	0	-79.20	74.60	120
11/ 2/1995	20:59:	0	-78.60	19.00	71
11/12/1995	0:26:	0	-77.90	323.50	273
11/20/1995	22:48:	0	-79.80	359.90	247
2/ 1/1996	17:55:	0	-78.70	64.10	119
2/29/1996	0:52:	0	-78.40	318.00	251
3/ 8/1996	23:14:	0	-79.70	351.30	279
3/27/1996	6: 7:30	-78.50	239.00		122
5/20/1996	16:37:30	-79.60	88.60		132

4/23/1996	12:13:30	78.40	326.90	124
6/17/1996	0:24:30	79.10	147.60	205
7/ 5/1996	3:54:30	78.70	92.20	134
7/14/1996	3:57:30	79.90	100.20	145
7/23/1996	7:24: 0	79.10	42.20	123
8/ 1/1996	9: 9: 0	78.60	12.70	117
8/10/1996	10:53:30	79.20	350.20	124
8/19/1996	12:38:30	78.60	320.00	123
8/28/1996	14:23: 0	79.10	296.80	116
9/ 6/1996	14:26: 0	80.00	302.60	145
9/15/1996	17:52:30	78.80	242.50	122
9/24/1996	17:55:30	79.70	247.60	126
10/ 3/1996	19:40: 0	80.00	224.20	139
10/12/1996	23: 6:30	78.80	163.50	128
10/21/1996	23: 9:30	79.70	168.40	129
10/22/1996	0:51: 0	79.20	139.50	126
10/31/1996	0:54: 0	79.90	143.80	128
11/ 9/1996	2:38:30	80.00	118.80	131
11/18/1996	6: 5: 0	78.70	57.60	132
11/27/1996	7:49:30	78.80	31.70	130
12/ 6/1996	9:34: 0	78.80	5.50	132
12/15/1996	11:18:30	78.80	339.10	133
12/24/1996	11:21: 0	80.20	348.90	146
1/ 2/1997	13: 5:30	80.00	321.60	136
1/11/1997	16:31:30	79.50	265.10	134
1/20/1997	18:16: 0	79.30	237.60	119
1/29/1997	20: 0:30	79.10	210.10	114
2/ 7/1997	21:45: 0	78.90	182.30	129
2/16/1997	23:29: 0	79.70	162.20	138
2/25/1997	23:32: 0	79.90	163.00	153
6/24/1997	1:30: 0	78.80	123.10	290
7/ 2/1997	23:50:30	80.70	164.40	235
7/30/1997	6:44:30	79.30	47.30	117
8/ 8/1997	6:46:30	80.50	57.80	144
10/19/1997	20:37:30	79.90	202.80	115
10/28/1997	22:21:30	79.50	172.70	136
11/ 6/1997	22:23:30	80.40	180.20	111
11/ 7/1997	0: 5: 0	79.90	150.70	166
2/14/1998	17:23: 0	79.90	249.10	109

2/23/1998	19: 6:30	79.80	222.50	118
3/ 4/1998	20:50: 0	79.70	195.50	129
3/13/1998	22:33:30	79.50	168.10	146
3/22/1998	22:35: 0	80.70	178.70	130
3/23/1998	0:16:30	80.30	148.80	164
4/ 1/1998	0:18:30	80.40	149.60	117
4/10/1998	2: 1:30	80.90	129.80	138
4/19/1998	3:45: 0	80.60	99.40	101
7/28/1998	0:21: 0	79.80	141.00	184
10/ 8/1998	12:22: 0	80.50	326.90	103
10/17/1998	14: 4:30	80.70	303.70	92
10/26/1998	15:47: 0	80.90	281.10	115
11/ 4/1998	17:29:30	81.00	256.20	120
11/13/1998	19:12: 0	81.00	231.50	127
11/22/1998	22:36:30	80.30	170.20	74
12/ 1/1998	22:37: 0	80.80	176.40	103
12/ 2/1998	0:18:30	80.50	146.30	174

**Class II SNOs between NOAA-14 and NOAA-15**

DATE	TIME	SAT	LAT/LON	DIST (KM)
5/10/1998	17:40:30	-79.40	77.00	66
8/ 9/1998	21:54:30	79.60	194.50	67
10/12/1998	20: 6: 0	79.20	226.10	83
4/22/1999	18:42: 0	-79.30	71.20	99
7/ 4/1999	23:31:30	-79.40	359.30	97
7/14/1999	2: 4: 0	80.00	135.20	94
5/29/2000	21: 4:30	-80.00	39.90	74
8/11/2000	8:13: 0	-80.30	230.60	86
10/ 5/2000	10:56:30	-80.60	185.10	95
5/ 5/2001	0:47:30	-80.80	340.70	78
11/23/2001	12:23:30	-80.90	166.50	84
7/11/2002	6:57:30	-80.70	246.90	96
1/ 1/2003	12:41:30	-78.80	142.10	95
1/ 1/2003	13:32: 0	79.60	315.80	29
1/10/2003	16:44: 0	77.80	255.80	79
1/10/2003	17:34: 0	-79.80	78.40	76
1/19/2003	20:46: 0	-78.20	17.80	44
1/29/2003	0:48: 0	78.20	137.50	4
2/ 7/2003	4: 0: 0	75.90	79.50	91

2/ 7/2003	4:50: 0	-78.20	257.60	22
2/16/2003	8: 2: 0	-75.90	199.20	80
2/25/2003	12: 4: 0	75.80	318.90	0
3/ 6/2003	16: 6:30	-74.10	73.40	22
3/15/2003	19:19:30	-67.80	14.40	62
3/15/2003	20: 9: 0	72.40	189.30	79
3/24/2003	23:21:30	67.30	133.70	11
4/ 3/2003	2:37:30	50.00	73.50	99
4/ 3/2003	3:23: 0	-68.20	254.80	61
4/12/2003	6:40: 0	-47.80	192.40	4
4/12/2003	6:54: 0	0.90	178.50	89
4/21/2003	10: 4:30	0.00	131.40	69
4/21/2003	10:43: 0	43.10	310.40	42
4/30/2003	14: 6: 0	0.40	251.50	24
4/30/2003	14: 9:30	-11.80	248.60	15
5/ 9/2003	17:32: 0	-52.50	188.20	22
5/ 9/2003	18:16:30	30.20	3.80	83
5/18/2003	20:48: 0	-70.00	125.40	93
5/18/2003	21:35:30	58.90	304.30	23
5/28/2003	0:50: 0	71.30	243.10	35
6/ 6/2003	4: 2: 0	75.40	185.90	92
6/ 6/2003	4:51:30	-71.00	3.70	34
6/15/2003	8: 3:30	-75.30	306.20	37
6/24/2003	12: 4:30	73.70	70.50	60
7/ 3/2003	15:16: 0	76.40	14.70	4
7/ 3/2003	16: 6:30	-75.50	185.60	96
7/12/2003	18:27:30	78.80	314.60	73
7/12/2003	19:17:30	-76.80	133.40	48
7/21/2003	22:28:30	-78.00	79.70	2
7/31/2003	1:39:30	-79.20	24.70	40
7/31/2003	2:30: 0	78.40	197.40	28
8/ 9/2003	4:50:30	-80.10	326.70	98
8/ 9/2003	5:40:30	78.50	149.40	9
8/18/2003	8:51:30	79.70	92.70	50
8/27/2003	12:52:30	-79.20	217.40	53
9/ 5/2003	16: 3: 0	-79.40	167.70	10
9/14/2003	19:14: 0	-80.40	108.00	58
9/14/2003	20: 4:30	79.90	282.30	59
9/23/2003	23:15: 0	80.20	231.00	12

**Class II SNOs between NOAA-15 and NOAA-16**

DATE	TIME	SAT	LAT/LON	DIST (KM)
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9/22/2000	12:31:30	-78.00	155.10	87
9/30/2000	6:57: 0	78.60	55.40	42
9/30/2000	12:51:30	-79.00	144.00	85
10/ 7/2000	10:11:30	-78.50	187.50	97
10/24/2000	17:13:30	-78.40	82.70	92
4/11/2001	22:40: 0	79.00	176.10	74
4/28/2001	3:30: 0	-78.70	285.20	77
9/28/2001	11:17: 0	78.80	347.30	46
12/18/2001	5:15: 0	78.90	77.00	95
5/21/2002	3:22:30	-78.70	287.20	97
1/ 3/2003	0:56:30	79.50	138.10	96
1/11/2003	3:41: 0	-79.40	278.30	89
1/19/2003	6:25:30	79.30	58.00	99
5/21/2003	2: 1:30	79.50	122.90	98
9/ 3/2003	17:45: 0	79.30	249.60	88
10/30/2003	13:40:30	79.60	308.20	92
11/24/2003	0:23: 0	79.30	150.50	91

**Class II SNOs between NOAA-16 and NOAA-17**

DATE	TIME	SAT	LAT/LON	DIST (KM)
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11/ 8/2003	0: 0: 0	72.00	183.30	27
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- NESDIS 116 Microwave Humidity Sounder Calibration Algorithm. Tsan Mo and Kenneth Jarva, October 2004.

## NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

*The National Oceanic and Atmospheric Administration* was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

The major components of NOAA regularly produce various types of scientific and technical information in the following types of publications:

**PROFESSIONAL PAPERS** - Important definitive research results, major techniques, and special investigations.

**CONTRACT AND GRANT REPORTS** - Reports prepared by contractors or grantees under NOAA sponsorship.

**ATLAS** - Presentation of analyzed data generally in the form of maps showing distribution of rainfall, chemical and physical conditions of oceans and atmosphere, distribution of fishes and marine mammals, ionospheric conditions, etc.

**TECHNICAL SERVICE PUBLICATIONS** - Reports containing data, observations, instructions, etc. A partial listing includes data serials; prediction and outlook periodicals; technical manuals, training papers, planning reports, and information serials; and miscellaneous technical publications.

**TECHNICAL REPORTS** - Journal quality with extensive details, mathematical developments, or data listings.

**TECHNICAL MEMORANDUMS** - Reports of preliminary, partial, or negative research or technology results, interim instructions, and the like.



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