# 1. Introduction and Executive Summary

In the fall of 1987, responding to the serious ozone depletion reported in Antarctica, the Division of Polar Programs of the National Science Foundation called for the establishment of an Ultraviolet (UV) Monitoring System in Antarctica. In its 11th year, this network is the first automated, longest operating, high-resolution UV scanning spectroradiometer network in the world. It has been operationally successful in the harshest environments of Antarctica and the Arctic and is currently returning data to researchers studying the effects of ozone depletion on terrestrial and marine biological systems. In addition, this data is being used to develop and verify models of atmospheric light transmission and the impact of ozone depletion.

Spectroradiometers were installed in four locations between February and November 1988; a fifth instrument was installed at Barrow, Alaska in December 1990. The San Diego system, installed in November 1992, is a multi-purpose system used for collecting solar irradiance data, training site operators, evaluating and testing engineering improvements, and comparing measurements of other types of UV instrumentation. The following table lists the positions and the period of data referred to in this report for these sites.

**Table 1.1. NSF spectroradiometer installation sites.**

| ID # | Site | Longitude | Latitude | Established | Normal Season |
|---|---|---|---|---|---|
| 1 | McMurdo, Antarctica | 166º40'E | 77º51'S | March 1988 | August – April |
| 2 | Palmer, Antarctica | 64º03'W | 64º46'S | May 1988 | Year-round |
| 3 | South Pole, Antarctica | 0 | 90º00'S | February 1988 | September - March |
| 4 | Ushuaia, Argentina* | 68º19'W | 54º49'S | November 1988 | Year-round |
| 5 | San Diego, California** | 117º11'W | 32º45'N | November 1992 | Year-round |
| 6 | Barrow, Alaska*** | 156º47'W | 71º18'N | December 1990 | January – November |

*CADIC: Centro Austral de Investigaciones Cientificas, Argentina
**Biospherical Instruments Inc.
***UIC/NARL: Ukpeagvik Inupiat Corporation (formerly) Naval Arctic Research Laboratory

Depending on the time of year, data scans are conducted quarter-hourly when the sun is above the horizon. Data are collected on a reduced schedule at night. Peripheral data (Eppley sensors, TSI, various system temperatures, and monochromator position) are collected over 24 hours at intervals ranging from 1 to 60 minutes. At sites inside the Arctic or Antarctic circles, instrument operation is on a reduced scan schedule during the winter darkness.

Several classes of data are available to the various segments of the research community. **Level 1** data are in their original binary form and are uncorrected for offsets or wavelength errors. **Level 2** data have been referenced to calibration constants determined at the beginning of the season, which have been corrected for wavelength errors and daily changes in responsivity. These corrections are based on daily scans of the internal Hg and 45-Watt tungsten-halogen lamps employed in each system to determine wavelength and instrument responsivity. Level 2 data are available in near "real time" at most sites for approved NSF-sponsored researchers conducting research at that site. These data are provisional however; investigators are cautioned to check with Biospherical Instruments before any "final" conclusions or publications are made using these data, as they are subject to revision. **Level 3** data are referenced to both beginning- and end-of-season calibration events ("site visits") in order to compensate for system changes, long-term drifts such as calibration lamp aging or other effects. Furthermore, Level 3 data include corrections for instrument and ambient temperature fluctuations, as well as other retrospective corrections. Level 3 data are distributed on CD-ROM, via the Internet by File Transfer Protocol (FTP), and as e-mail attachments. These data sets are generally available to any researcher (request data through NSF, ASA, or directly from Biospherical Instruments Inc). Level 3 data are normally made available sometime after the final site visit for the period covering the previous "season," most typically the previous 12 months.

The spectroradiometer is based on a temperature-stabilized, scanning double monochromator coupled to a photomultiplier tube (PMT) detector. The system is optimized for operation in the UV. A vacuum-formed Teflon® diffuser serves as an all-weather irradiance collector and is conductively heated by the system to minimize ice and snow buildup. The instrument has internal wavelength and intensity calibration lamps for daily automatic calibrations at programmed intervals (typically once each, per day). Data acquisition system and control instrumentation accompanies the instrument. Starting in mid-1996, Pentium® microprocessor-based personal computers (PC), using the Windows NT® operating system, were put into use for system control and data collection. For additional information on system hardware see Chapter 2 of this report.

Data are processed in units of $\mu W/(nm \cdot cm^2)$ and are available in two formats: "databases" where a time series of parameters of interest are collected, and individual files with full spectral resolution for each solar data scan. There are three types of databases: spectral integrals including dose weightings, irradiances at selected wavelengths, and quality control. Data at the full spectral resolution are available as individual data files for each scan segment (see Chapter 3 and Appendices A2 through A6 for more information). Due to the large number of these full-resolution files (up to 30,000+ per site, per year), they are distributed on CD-ROM in comma separated value format (CSV, ISO 9660). These files are also available by other means of electronic distribution. Please contact Biospherical Instruments Inc. for details.

Over the years, this network of instruments has provided data for the support of several research programs, the details of which may be found in the following references: Anderson et al. (1993); Benavides et al. (1994); Booth et al. (1988, 1990, 1991, 1992, 1993, 1994, 1997); Cullen et al. (1992); Day et al. (1998); Díaz et al. (1990, 1991, 1994, 1996); Frederick et al. (1988, 1991, 1993, 1994, 1998); Holm-Hansen et al. (1993, 1994, 1997, 1998); Karentz et al. (1990, 1991, 1992, 1994, 1995, 1997); Lewis (1997); Lubin and Frederick (1989, 1991, 1992); Lubin et al. (1989, 1992, 1995); Madronich (1993, 1994); Malloy (1997); Ricchiazzi et al. (1995, 1996); Rowland (1989, 1996); Seckmeyer et al. (1995, 1998); Smith et al. (1989,1991,1992); Stamnes (1993); Stamnes et al. (1990,1991, 1992); and Thompson et al. (1997).

The balance of this report describes much of the preceding information in detail, and serves as a guide to researchers using the various databases and high-resolution data products resulting from this project.