Jahresbericht 2001

Physikalisch-Meteorologisches Observatorium Davos
World Radiation Center

Annual Report 2001

A department of the Foundation

Swiss Research Institute for High Altitude Climate and Medicine Davos

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SFI

Schweizerisches Forschungsinstitut für Hochgebirgsklima und Medizin

DAVOS

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Zusammenfassung Jahresbericht 2001

Vorwort

Dr. Claus Fröhlich wurde auf Ende Jahr pensioniert. Er hat in seinen 32 Jahren als Mitarbeiter, davon 25 Jahren als Direktor, das PMOD/WRC geprägt und mit seinen erfolgreichen Weltraumprojekten dem PMOD/WRC zu Weltruf verholfen. Ich möchte Dr. Claus Fröhlich an dieser Stelle für seine Leistungen gratulieren und im Namen des Observatoriums herzlich danken.

Mit den laufenden Projekten SOVIM und PREMOS führen wir die Weltraumtradition des Observatoriums weiter und letztes Jahr ist mit der Sicherstellung der Finanzierung von PREMOS durch PRODEX ein wichtiger Schritt geglückt. Auch das von mir geleitete ETH-Polyprojekt „Variabilität der Sonne und Globales Klima“ konnte diese kritische Hürde nehmen: seit letztem Herbst ist das Projekt offiziell genehmigt. Das Projekt war provisorisch schon im Jahr 2000 gutgeheissen worden, mit der Auflage, erst einen ausgewiesenen Projektwissenschaftler zu finden. Dies gelang per Januar 2001 mit der Anstellung von Dr. Eugene Rozanov, den wir von der University of Illinois in Urbana-Champaign, USA nach Davos holen konnten. Mittlerweile sind auch drei der vier Doktorandenstellen des Projektes besetzt, wobei zwei Doktorandinnen in Davos arbeiten. Von ebenso wichtigerer Bedeutung für das PMOD/WRC war, dass auch das langjährige SNF-Forschungsprojekt, das einen Teil der Infrastruktur des PMOD/WRC trägt, per Oktober 2001 um weitere zwei Jahre verlängert wurde.

Dienstleistungen und Messnetze

Das PMOD/WRC kalibrierte für 12 Auftraggeber 54 Instrumente und konnte dafür rund CHF 50'000.- einnehmen. Die Anzahl Aufträge war deutlich über dem Durchschnitt und somit übersteigen erfreulicherweise auch die Einnahmen den budgetierten Betrag.

Das GAW-Versuchsmessnetz zur Überwachung der Aerosol optischen Dicke ist um die vier Stationen Bratt’s Lake in Kanada, Izãna auf Teneriffa, Rzori in Japan und Alice Springs in Australien erweitert worden. Die Präzisions-Filterradiometer (PFR) der bisherigen Stationen haben sich weiterhin im Dauerbetrieb bewährt und hielten ihre Kalibrierung innerhalb der geforderten 1% Genauigkeit. Die von den Messungen des PMOD/WRC Instruments auf Mauna Loa in Hawaii abgeleiteten Aerosol Optischen Dicken (AOD) stimmen mit den entsprechenden Resultaten des amerikanischen Aeronet Messnetzes, das auch auf Mauna Loa eine Station unterhält, hervorragend überein. Der automatische Filter Algorithmus, der durch Wolkeneinfluss verfälschte Messwerte eliminiert, ist durch weitere Beurteilungskriterien erweitert worden und hat sich im praktischen Einsatz als verlässlich erwiesen.

Das PMOD/WRC eigene Pyrgeometer Messnetz für Infrarot-Strahlung liefert weiterhin zuverlässige Daten. Bis auf eines sind alle Geräte des Alpine Surface Radiation Budget Messnetzes (ASRB) im Verlauf von 2000 und 2001 neu kalibriert worden, wobei auch das mobile Standardinstrument zweimal mit den Referenzgeräten in Davos verglichen wurde. Es stellte sich heraus, dass die Pyrgeometer seit dem Start der Messreihe bis auf kleinere Korrekturen der Kalibrierfaktoren stabil geblieben sind.

Das Schweizerische UV-Messnetz, das als Zusammenarbeit zwischen der MeteoSchweiz und dem PMOD/WRC 1995 aufgebaut worden ist, wurde für den oparationellen Betrieb auf vier Stationen reduziert. Eine fünfte Station wird vom PMOD/WRC weiterhin zu Forschungszwecken auf dem Versuchsfeld des Instituts für Schnee- und Lawinenforschung auf dem Weissfluhjoch betrieben. Das verkleinerte Messnetz liefert die globalen Strahlungswerte im UVA und UVB sowie, mittels UV-Präzisions-Filterradiometer, die direkt einfallende UV-Strahlung der Sonne in vier Schmalband-UV-Kanälen.

Entwicklung und Bau von Instrumenten

Die neuen PMO6-cc Pyrheliometer zur Messung der direkten Sonnenstrahlung wurden ausgiebig getestet und dabei kamen Probleme mit der Elektronik zum Vorschein. Die Mängel konnten behoben werden und die Instrumente sind nun, bis auf die Feinabstimmung der Elektronik und Kalibrierung vor Sonne, zum Verkauf bereit. Im letzten Jahr konnten zwei PMO6-cc, ein PMO6 einer früheren Serie und eine neue Computer-

Kontrollelektronik zur Steuerung eines älteren PMO6 mit entsprechend positivem Einfluss auf den Jahresabschluss verkauft werden.

Weltraumexperimente VIRGO, SOVIM und PICARD

Das PMOD/WRC Experiment VIRGO auf dem Satelliten SoHO liefert auch nach sechs Jahren im Weltraum genaueste Messwerte der totalen Sonnenstrahlung. Das zeitliche Verhalten der VIRGO Radiometer hatte etliche, vor der Mission nicht erwartete Überraschungen gebracht und die Analyse gestaltete sich langwierig und schwierig. Diese Untersuchung ist nun abgeschlossen und das Empfindlichkeitsverhalten der zwei Radiometer-Typen auf VIRGO ist nun bestimmt.

Der Bau des Weltraumexperiments SOVIM, das für die Messung der totalen Sonnenstrahlung auf der Internationalen Raumstation (ISS) vorgesehen ist, schreitet mit nur geringer Verspätung planmässig voran. Es wurde begonnen erste Teile der Flugmodelle zu fertigen und auch die Elektronik der Fluginstrumente ist nun festgelegt. Die Fertigung der Deckel durch Contraves Space wurde leicht verzögert, da bei mechanischen Tests Mängel aufgetreten waren. Der Bauplan wurde entsprechend verbessert und die Flugversionen der Deckel sind mittlerweile fast fertiggestellt.

Die Arbeit an PREMOS, dem PMOD/WRC 4-Kanal Filterradiometer für das französische Weltraumexperiment PICARD, wurde bis zur Sicherung der Finanzierung durch den Schweizerischen PRODEX Fonds vorübergehend eingestellt, aber nach erfolgter Zusage der Mittel im August wieder mit Elan aufgenommen worden. Der Start von PICARD soll im Jahr 2006 stattfinden.

ETH Polyprojekt „Variabilität der Sonne und Globales Klima“

Das ETH-Polyprojekt ist eine Zusammenarbeit mit den ETH Instituten für Astronomie und für Atmosphären- und Klimawissenschaften unter der Führung des PMOD/WRC. Das Ziel des Projekts ist es, den vermuteten Einfluss der variablen Sonne auf das Erdklima zu erforschen. Insbesondere soll der Einfluss der UV Strahlung auf die Ozonkonzentration und auf die Konzentration anderer Spurengase untersucht werden. Dazu wurde im vergangenen Jahr ein neues Computerprogramm erstellt, das wir SOCOL getauft haben (Solar Climate Ozone Link; Socol ist das Russische Wort für Falke). Das Computerprogramm SOCOL wurde aus dem Globalen Zirkulationsmodell des Max Planck Instituts für Meteorologie in Hamburg und dem Chemischen Transport Modell unseres Projektmanagers zusammengefügt. Erste Kontrollrechnungen mit dem SOCOL Programm konnten erfolgreich die saisonale Ozonverteilung über den Polen reproduzieren.

Eine Studie mit dem Chemischen Transport Modell, welche Wellenlängen den Ozon Auf- und Abbau verursachen, brachte das überraschende Resultat, dass die wirksame UV-Strahlung von einem kleinen Wellenlängenbereich zwischen 200 und 220 nm dominiert wird. Dieses Resultat ist einerseits für die Filterwahl für unser Weltraumexperiment PREMOS bedeutsam und anderseits für unsere Bemühungen, das variable Sonnenspektrum mit Sonnenatmosphären-Modellrechnungen möglichst genau zu rekonstruieren. Unsere bisherigen Berechnungen versagten gerade in dem kritischen Bereich unterhalb 200 nm.

Sonnenphysik

Die Suche nach den g Moden ist auch weiterhin ein Thema am PMOD/WRC. Da die bisherigen Untersuchungen der VIRGO Beobachtungsreihen keine verlässliche Entdeckung dieser Moden bringen konnten, hat man im vergangenen Jahr die Daten des MDI Instruments auf SoHO analysiert. Der Vorteil dieses Instruments ist, dass die Sonne als Scheibe aufgelöst beobachtet wird und dass deshalb die Daten für die Suche der Moden mit vorteilhaften Masken vor der Analyse gefiltert werden können. Die neue Methode hat sich insofern bewährt als die Entdeckungsempfindlichkeit für g Moden gesteigert werden konnte. Leider konnten nach wie vor keine g Moden zweifelsfrei nachgewiesen werden.

Aus Zusammenarbeiten mit dem Astronomischen Institut der ETH und dem MPA Lindau resultierten verschiedene Publikationen auf den Gebieten der Sonnen- und der Astrophysik mit PMOD/WRC Mitarbeitern als Mitautoren.

Treibhauseffekt in den Alpen und Pyrgeometer Vergleiche in Alaska

Der Treibhauseffekt wird üblicherweise von Satelliten aus untersucht, obwohl die Wärmestrahlung am Boden aus einer nur 1 km dicken Schicht über der Oberfläche resultiert und der kritische Bereich von Satelliten im infraroten Spektralbereich gar nicht eingesehen werden kann. Die Messdaten unseres ASRB Messnetzes erlauben uns den Treibhauseffekt vom Boden aus zu untersuchen. Insbesondere können wir mit unserem Messnetz die Abhängigkeit des Treibhauseffekts von der Höhe des Beobachtungsstandortes quantifizieren. Numerische Simulationen der Beobachtungen bei klarem Himmel zeigten, dass man die Atmosphärenphysik bei einfachen Bedingen relativ gut versteht.

Die Verlässlichkeit der Infrarot-Strahlungsmessungen steht und fällt mit der Qualität der Messinstrumente. Da die Messunsicherheit erst in den letzten Jahren auf die für eine qualitative Untersuchung der IR-Strahlung erforderliche Genauigkeit gebracht wurde, ist es wichtig, die neuen Instrumententypen mit Vergleichsmessungen auf systematische Fehler zu testen. Insbesondere könnte eine Abhängigkeit vom Wasserdampfgehalt der Atmosphäre systematische Fehler erzeugen, da der Wasseranteil auf verschiedenen geographischen Breiten sehr unterschiedlich sein kann. Nach den ersten Vergleichen 1999 in Oklahoma ist im letzten März der zweite Vergleich durchgeführt worden, diesmal im hohen Norden in Barrow, Alaska. Wie schon beim ersten Vergleich ergaben erste Analysen, dass die Geräte auch in Alaska sehr genaue IR-Strahlungswerte messen.

Mehrjahresmittel der Aerosol Optischen Tiefe in Davos

Die Davoser Messreihe der Aerosol Optischen Tiefe der letzten sechs Jahre ist mit Daten verglichen worden, die zwischen 1914 und 1926 gemessen wurden. Aus dem Vergleich der beiden Datensätze lässt sich schliessen, dass vor achtzig Jahren die atmosphärische Trübungen während den Sommer- und Herbsttagen kleiner als heute war. Allerdings ist noch nicht untersucht, welchen systematischen Einfluss die unterschiedlichen Messfrequenzen auf die Messwerte haben: Heutzutage beobachten die automatischen Instrumente ununterbrochen, während früher nur bei schönen Tagen gemessen wurde.

Internationale Zusammenarbeit

Der Schweizerische Nationalfonds unterstützt die Zusammenarbeit mit Osteuropäischen Staaten mit einem speziellen Fonds namens SCOPES (Scientific Collaboration between Eastern Europe and Switzerland). Zusammen mit Kollegen des Departements für Sonnenphysik des Ulugh Beg Astronomischen Instituts der Usbekischen Wissenschaftsakademie in Taschkent hat das PMOD/WRC das Projekt „Characteristics of Low Degree Solar Oscillations from Observations in Brightness and Velocity" eingereicht. Wir erhielten CHF 50'000.00 zugesprochen mit dem wir während 30 Monaten einen Teil der Saläre von sieben unserer Usbekischen Kollegen bezahlen.

Infrastruktur

Die im Jahr 2000 begonnene schrittweise Renovation des PMOD/WRC konnte auch letztes Jahr weitergeführt werden. Wir haben die Herrentoilette im ersten Stock zu einem geräumigen Labor mit einem Reinluft-Arbeitsplatz umgebaut und der Raum in dem die Reinraumzelle vorher untergebracht war, in ein neues 1-Personen Büro umgewandelt. Die restlichen, noch nicht renovierten Räume im ersten Stock wurden gestrichen und mit Teppichen ausgestattet, bzw. der Arbeitsplatz der Laboranten wurde mit geerdeten Bodenplatten versehen.

Lehrverpflichtungen

An der ETH Zürich wurden folgende Vorlesungen gehalten: W. Schmutz im Wintersemester 2000/2001 die Vorlesung „Astronomie" gemeinsam mit Prof. Dr. H. Nussbaumer, ETH Zürich, im Sommersemester 2001 „Galaxien" mit Prof. Dr. S.K. Solanki, Direktor Max-Planck Institut für Aeronomie, und im Wintersemester 2001/2002 die Vorlesung „Astronomie". C. Fröhlich im Wintersemester 2000/2001 die Vorlesungen „Strahlung und Klima" und gemeinsam mit Prof. Dr. M.C.E. Huber, ESA Science Directorate Paris, „Wissenschaft im Weltraum: Erkundung des

Sonnensystems, Physik und Astronomie“. R. Philipona in den Wintersemestern 2000/2001 und 2001/2002 die Vorlesung „Strahlungsmessung in der Klimaforschung“.

Personelles

Ende Mai, nach exakt 5 Jahren am PMOD/WRC, zog es Remo Venturi wieder zurück ins Unterland. Herr Venturi war vier Jahre lang verlässlicher Hüter der Weltstandardgruppe und ein Jahr lang hat er die Radiometrie als Physiklaborant unterstützt. Ich danke Herrn Venturi für seinen Beitrag zum Erfolg des Observatoriums. Sein Nachfolger in der Betreuung der WSG, Mario Roveretto, verliess das PMOD/WRC per Ende Jahr zugunsten einer attraktiven Informatikstelle beim AO Davos. Auch er verdient Dank für seine zuverlässige Arbeit. Der neue Betreuer der WSG ist Christian Thomann.

Neue Doktoranden am PMOD/WRC sind Margit Haberreiter, Physikerin der Universität Tübingen und Dr. Tatiana Egorova, promovierte Physikerin des Geophysikalischen Observatoriums St. Petersburg. Beide sind im Rahmen des ETH-Polyprojekts angestellt.

Auch nach dem dritten Jahr Zivildienst am PMOD/WRC sind wir sehr zufrieden mit dieser vielseitig einsetzbaren Unterstützung unseres Betriebs. Während 2001 waren fünf Dienstleistende im Einsatz.

Dank

Der finanzielle Abschluss 2001 ist dank dem erfolgreichen Verkauf unserer Instrumente positiv ausgefallen. Damit realisieren wir einen Gewinn aus unseren langjährigen Investitionen in den Instrumentenbau. Ich danke allen Mitarbeiter für ihren Beitrag zum Erfolg des Observatoriums.

Es gehört zu den Aufgaben der Aufsichtskommission und des Stiftungsratsausschusses die Tätigkeiten des PMOD/WRC mit Rat und Tat zu unterstützen. Im vergangenen Jahr ging diese Unterstützung weit über das übliche Mass hinaus: die MeteoSchweiz und die Stiftung haben ausserordentliche finanzielle Mittel gesprochen, um am PMOD/WRC ein Kalibrierzentrum für Messgeräte der atmosphärischen Infrarotstrahlung aufzubauen. Ich bedanke mich bei beiden Gremien für Ihren Mut in die Zukunft des PMOD/WRC zu investieren. Ebenso verdient die Ernst Göhner

Stiftung eine Verdankung, da sie uns ausserordentliche Anschaffungen ermöglicht hat. Auch bedanken möchte ich mich beim Förderverein, dem Stiftungsrat, bei den kommunalen und kantonalen Behörden, beim Nationalfonds und bei der Schweizerischen Unterstützung unserer Weltraumprojekte im Rahmen des PRODEX Programms.

Davos, im März 2002 Dr. Werner Schmutz, Privatdozent ETH Zürich

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Introduction

Werner Schmutz

After celebrating his 65th birthday, Dr. Claus Fröhlich retired from the PMOD/WRC at the end of last year. In his 32 years as a staff member of the PMOD/WRC, 25 of which he spent as director, he shaped the PMOD/WRC and brought world renown to the institute as a result of his successful space experiments. I would like to take this opportunity to congratulate Dr. Claus Fröhlich on his successes and express the deep appreciation of the staff of the PMOD/WRC for his efforts on behalf of the observatory.

With the ongoing projects SOVIM und PREMOS we continue the PMOD/WRC tradition of building space experiments. Last year the PRODEX grant for PREMOS was approved; this was a necessary step for our commitment to the French micro-satellite PICARD. The ETH-Polyproject „Variability of the Sun and Global Climate“ was also finally approved. A provisional approval had been granted already in 2000, with the requirement that a search be undertaken for an experienced senior scientist who could serve as project manager. This condition was fulfilled with the employment of Dr. Eugene Rozanov, who moved to the PMOD/WRC from the University of Illinois in Urbana-Champaign in January. By the end of 2001 we had filled three of the four PhD student positions that had been granted; two PhD students are working in Davos. Also significant for the future of the PMOD/WRC was the approval of the continuation of the main PMOD/WRC long-term project financed by the Swiss National Science Foundation. As this SNF project supports part of the infrastructure of the observatory, the approval of this grant was particularly important and noteworthy.

Calibrations

Isabelle Rüedi, Rolf Philipona, Mario Roveretto, Christian Thomann, Remo Venturi, and Christoph Wehrli

The PMOD/WRC is responsible for the world-wide homogeneity of the meteorological radiation measurements. For this purpose, we maintain the

World Standard Group (WSG) which comprises 6 radiometers of different type and make. The WSG materializes the World Radiometric Reference (WRR), which is the reference adopted by the WMO as the basis for all meteorological radiation measurements. The world-wide dissemination of the WRR is secured by the International Pyrheliometer Comparisons, which are carried out on a five year basis. The last comparisons were in autumn 2000.

During 80 sunny days 9 absolute radiometers, 4 pyrheliometers and 21 pyranometers were calibrated with the Sun as a source and the WSG as reference. These instruments belong to 12 independent institutions.

With a black-body as radiation source we calibrated 20 pyrgeometers. Six instruments have been modified according to PMOD/WRC standards, implementing three dome thermistors in the dome.

For use in the GAW network we have calibrated 4 Precision Filter Radiometers (PFR) in the PMOD/WRC laboratory and outside, with the sun as a radiation source. As usual, the PFR N-01 and N-26, that are used as standards, were calibrated twice with the trap detector to monitor their stability.

GAW trial network

Christoph Wehrli

Precision Filter Radiometer (PFR) instruments were delivered to 4 new stations at Bratt’s Lake in Canada, Izaña on the Spanish island Tenerife, Ryori in Japan, and Alice Springs in Australia. The PFR at Bratt’s Lake has already participated in a field comparison of 5 instruments during summer 2001. Initial results, showing good agreement within the BSRN goal of 0.01 optical depths for the 3 direct beam radiometers were presented by McArthur et al. (2001) at the AAAR2001 conference. An overview of the GAW trial network was also presented there (Wehrli 2001).

At Izaña, a PFR is operational since June 2001, but intermittent problems with 2 out of 4 channels need to be resolved before the measurements become fully useable. No data were delivered yet from the instruments at Ryori and Alice Springs.

The 3 initial stations continued to operate smoothly during 2001. On site instrument calibration by a traveling standard at Mace Head had to be terminated in January 2001 due to a broken cable. Field calibration was maintained by exchange of instruments and re-calibration of the initial PFR at Davos. It has remained stable well within 1% and showed no spectral changes. The excellent results obtained in a 1-month field comparison between Aeronet and the PFR at Mauna Loa in December 1999 were fully confirmed during year 2000. Analysis of *in-situ* calibrations has shown 3 channels to be almost perfectly stable and 1 channel to drift smoothly by +1% in 2001.

The operational cloud-filtering algorithm reported last year was further improved by adding a second filter, based on the triplet method used by Aeronet, eliminating many false detection of clear sky conditions and improving the quality of automatically processed data (Smirnov et al. 2000).

References

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Wehrli C.: 2001, New trial phase of the WMO/GAW aerosol optical depth network; *American Association for Aerosol Research, 20th Annual Conference October 2001, Portland, USA.*

Smirnov A., Holben B.N., Eck T.F., Dubovik O., Slutsker I.: 2000, Cloud screening and quality control algorithms for the AERONET data base, Rem. Sens. Environ. 73, 337.

The ASRB network

Rolf Philipona and Bruno Dürr

The pyranometers and pyrgeometers at the 11 ASRB sites measure global shortwave and longwave downward radiation respectively, since 1994. To investigate the long-term stability of the ASRB instruments, Bruno Dürr performed a field calibration in 2000 and 2001. All sites except Les Diablerets could be visited (major transformations at the Les Diablerets site). In a first step all pyrgeometers were newly calibrated to a „Traveling Standard“ pyrgeometer, which was itself compared two times within one year to the WRC longwave reference instrument at Davos. First investigations show that the ASRB pyrgeometers were stable over the whole period since the start of the network in 1994. Minor corrections were made to the calibration factors and the data were recalculated accordingly. Scientific investigations using ASRB network data continue within the Swiss National Science Foundation project „Greenhouse effect in the Alps: by models and observations“. Comparisons of ASRB data to model calculations are shown in a separate paragraph later in this report.

Reference

Marty Ch., Philipona R., Fröhlich C., Ohmura A.: 2002, Altitude Dependence of Surface Radiation Fluxes and Cloud Forcing in the Alps: Results from the Alpine Surface Radiation Budget Network, Theoretical and Applied Climatology, in press.

Swiss UV Radiation Network

Rolf Philipona

UV-Radiation measurements in Switzerland were resumed in 1995 through collaboration between MeteoSwiss and PMOD/WRC. The Swiss UV network is collocated with the RASTA-stations (Radiometrische Automatische Stationen) of MeteoSwiss. Due to financial reasons, the RASTA network had to be limited to four base stations and now comprises the stations, Payerne, Locarno-Monti, Davos and Jungfraujoch. A fifth station is maintained by PMOD/WRC for research purposes in the investigation field of the snow and avalanche research institute (SLF) on the Weissfluhjoch. The RASTA-UV network is now fully operational and measures broadband UV radiation using erythemal weighted Solar Light UV-Biometer, primarily measuring the UVB component, and Solar Light UVA radiometers. Narrowband UV Precision Filter Radiometers (UV-PFRs) measure direct solar UV radiation at 305, 311, 318 and 332 nanometers and a bandwidth of 1.25 nanometers.

Instrument Development

Commercial Radiometer PMO6-cc

Isabelle Rüedi, Hansjörg Roth, Klaus Kruse, and Jules Wyss

The new PMO6-cc radiometer series allows automated operation of the measurements. Various parameters can be set to best fulfill the needs of the observations, like e.g. the number cycles, the duration of the closed and open phases, the integration time, the start time of the measurements. The PMO6-cc can also be remotely operated by a computer. PMO6-cc were tested during the course of the year and they were functioning well with the exception of problems with the electronics and control software. These problems have been identified and eliminated. It turned out that full functionality could only be achieved by adjusting each unit individually. Finally, the control software was updated to allow larger freedom and ease of use.

Three complete instruments were sold to (or ordered from) institutions in Hong Kong, France, and Holland. An additional control unit was sold to the ETH for upgrade of a radiometer of an older PMO6 series to automated use.

Future Space Experiment SOVIM

Claus Fröhlich, Dany Pfiffner, Hansjörg Roth, Isabelle Rüedi, Werner Schmutz, and Jules Wyss

SOVIM (Solar Variability Irradiance Monitor) is an experiment to measure the total and spectral solar irradiance to be placed on the International Space Station. Presently, the transfer to the station is scheduled for 2005 and the experiment will be placed on the Columbus module together with SOLSPEC (spectral irradiance 200–2500nm) and SOLACES (EUV irradiance) on the SOLAR Express Pallet. Since 1996 the PMOD/WRC is building SOVIM and the status of the instrument development is as follows.

The mechanical design is nearly finished and most of the mechanical problems are solved. The most serious problem is that the mass of SOVIM is still 0.5 kg too high. In December we have started to manufacture the mechanical parts of the SPM and PMO6 radiometer units.

In the last year we have located and removed bugs in several electronic units, partly refurbished from the SOVA experiment on EURECA. The electronic design of the new boards are nearly completed and the flight PCB are designed. The PCB for the SPM FM instrument units and the electronic parts have been delivered to the PMOD/WRC, so we are ready for assembly. The PCB's for the two new radiometers have been ordered.

The contractor who is responsible for the cover has changed the mechanical design because serious malfunctions have been revealed during the mechanical tests of the qualification model. Thus the fabrication of the mechanical parts of the five FM-units has been delayed, but the units will be ready for delivery to PMOD/WRC soon.

The onboard software is under revision. The contractor is preparing the updates, but before it can be finalized all details of the protocol has to be defined by the project.

The prototypes of the PMO6 radiometers have been tested with the sun as source and compared to the World Standard Group.

Future Space Experiment PREMOS

Werner Schmutz, Hansjörg Roth, Isabelle Rüedi, Christoph Wehrli, and Jules Wyss

PREMOS is a four channel filter radiometer which will be the PMOD/WRC contribution to the French micro-satellite PICARD. The project is a collaboration between PMOD/WRC, the French space agency (CNES), and the Centre National de la Recherche Scientifique, Service d‘Aeronomie Paris (CNRS). In order for the project to be eligible for support through the Swiss Prodex programme, the PICARD project had to be accepted by the European Space Agency. ESA's approval, pending since 2000 and delayed several times, was finally granted in the summer of 2001. The project passed the Earth Observation Program Board and the formal endorsement of the Swiss Prodex Programme Committee followed in August 2001. Prodex supports the PREMOS experiment from September 2001 until the end of 2006.

Although we experienced a temporary inactive period while waiting for the financial approval, once approval was granted we restarted the planning, checked compatibilities of the interfaces to the satellite, and developed a new concept for the thermal environment. In addition we re-defined the philosophy of the measurements and began to adjust the electronic components accordingly.

Scientific Research Activities

Polyproject „Variability of the Sun and Global Climate"

Werner Schmutz, Eugene Rozanov, Margit Haberreiter, and Tatiana Egorova

The PMOD/WRC is the leading institute in the ETH-Polyproject "Variability of the Sun and Global Climate". Our partners are the ETH Institutes for Astronomy (Prof. Dr. Jan Stenflo) and for Atmospheric and Climate Science (Prof. Dr. Atsumu Ohmura and Prof. Dr. Thomas Peter). We are investigating the effects of the variations of the solar irradiance, in particular the UV spectral variability, on atmospheric ozone and other trace gases to evaluate their influence on the dynamics and temperature of the atmosphere, from the mesopause to the Earth's surface. To fulfill this task we have developed a numerical model for analyzing the Solar-Climate-Ozone Links (SOCOL); this model is a combination of the MAECHAM4 General Circulation Model (GCM) provided by the German Max Planck Institute for Meteorology and the modified UIUC Chemical Transport Model (CTM, Rozanov et al. 2001). Our new GCM/CTM model is one component in our efforts to improve on previous attempts to understand the problem. The second component is on the input side: we are attempting to improve the reconstruction of the past solar irradiation with a more elaborate spectral synthesis of the variable solar spectrum. The project involves the senior scientist Dr. Eugene Rozanov as project manager and four PhD students, Thomas Wenzler working at the Institute for Astronomy, Margit Haberreiter and Tatiana Egorova at PMOD/WRC and the fourth position, that is not yet filled, at the Institute for Atmospheric and Climate Science. We hope to contribute a fundamental element to the understanding of the Sun-Earth connection.

Reference

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Modeling of the Global Climate and Ozone

Eugene Rozanov and Tatiana Egorova

During the first year of the Polyproject we completed the development of the GCM/CTM model SOCOL. SOCOL has been used in „off-line“ mode to calculate the distribution of the atmospheric species. As an example the geographical distributions of the simulated and observed total ozone over the NH in March and over the SH in October are presented in Figure 1. Over the NH the model captures well the location and strength of the main observed maxima, i.e. it successfully simulates the dynamically driven winter-spring ozone build-up. Over the SH the total-ozone maximum in mid-latitudes has the correct latitudinal position. The location of the "ozone hole" is reproduced reasonably well by the model, however its intensity is slightly underestimated.

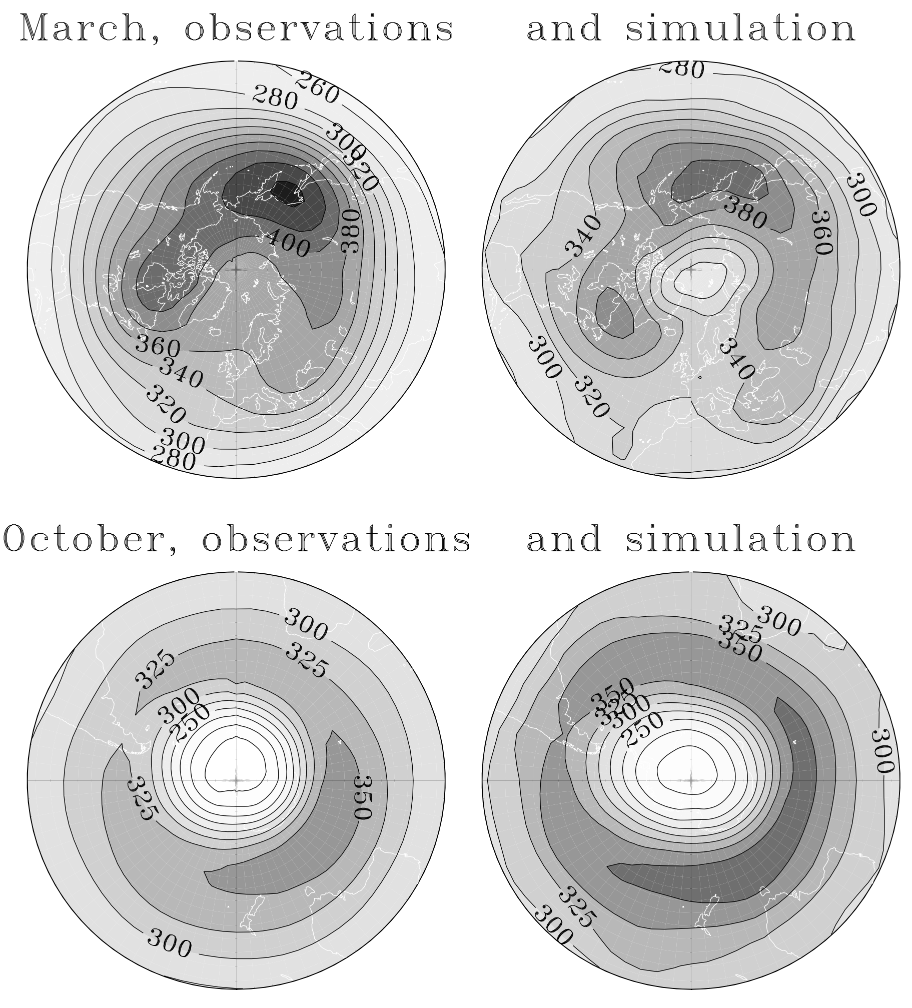

Figure 1. Comparison of the SOCOL simulation of the geographical distributions of total ozone (DU) for March and October with the observed distribution.

Sensitivity study with a 1-D climate-chemistry model

Eugene Rozanov and Tatiana Egorova

A 1-D climate-chemistry model has been applied to evaluate the sensitivity of the temperature and ozone to the spectral solar flux variability. We have performed one simulation using the spectral solar flux representing the quiet Sun period and a set of simulations where the solar flux for each spectral bin of the model has been taken from the observational data of the active Sun (see next section). The sensitivity of the temperature to the observed solar spectral flux variations is illustrated in Figure 2. It was found that the stratospheric temperature and ozone (not shown) have the highest sensitivity to the solar flux variations in the spectral range between 200 and 220 nm. In the upper stratosphere and mesosphere the ozone and temperature are very sensitive to the solar flux variability in the Lyman-alpha line (121.6 nm) and Schumann-Runge bands (180-200 nm). The obtained results are important for the choice of the wavelength band to be observed by satellite and it will also guide the formulation of radiation codes aimed at studying the solar-terrestrial climate connections.

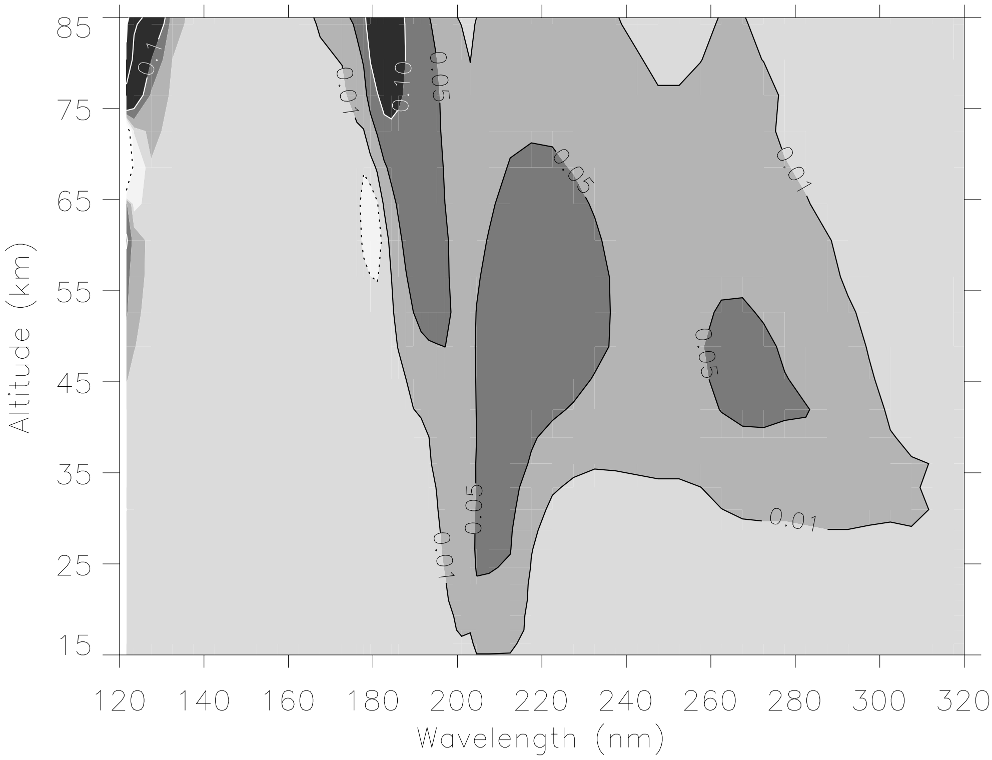

Figure 2. Computed temperature changes in [K] as function of wavelength due to the observed irradiance difference between maximum and minimum of the solar activity.

Reconstruction of the variations of the solar UV irradiance

Margit Haberreiter, Eugene Rozanov, and Werner Schmutz

While the total solar irradiance varies by 0.1% over a solar cycle, the UV radiation fluctuates by up to 100%. Solar irradiance variations are mainly caused by the changing flux contributions from regions of magnetic features on the solar disk, i.e. sunspots, faculae. We reconstruct the corresponding spectral energy distribution with a radiative transfer code. Weighting the components by the area they cover on the solar disk within a solar cycle, we derive the spectral irradiance variations. In Figure 3 we compare the theoretical result with data taken by the Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) on board the Upper Atmosphere Research Satellite (UARS). For wavelengths above 200 nm a good agreement between model and observation is achieved. However, towards shorter wavelengths the model has to be improved. In particular we are interested in the reconstruction of the variability of the irradiance of Lyα (121.6 nm) and two wavelength bands from 200 to 220 nm and 260 to 280 nm.

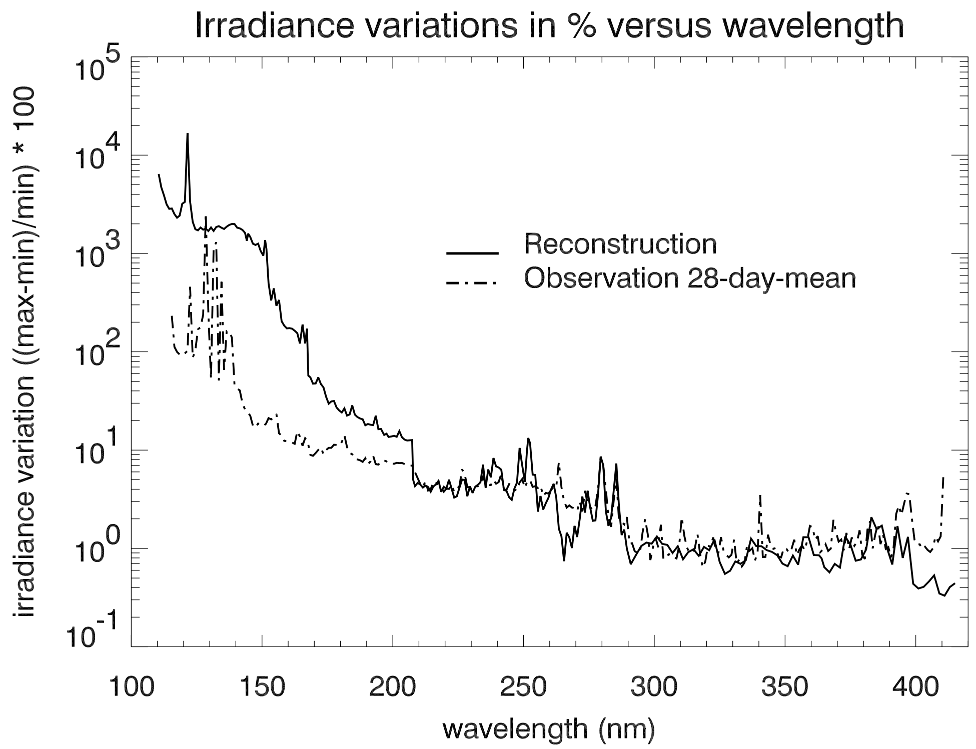

Figure 3. Comparison of the reconstructed UV irradiance variations with a 28-day-mean of SUSIM data. The agreement is good at longer wavelengths indicating that our approach is reasonable for small variations. However, at shorter wavelengths the increase in variability predicted by the model is too strong, most probably due to our assumption of local thermodynamic equilibrium, and improvements will be necessary.

Optimal Masks for g-mode detection in MDI data

Richard Wachter, Claus Fröhlich, and Werner Schmutz

The detection of solar g-modes has been a goal of helioseismological investigations for decades now. Theoretical predictions about the amplitudes of modes on the surface are highly uncertain, but the failure of their detection in longer and longer time series leads to a decreasing upper limit of their surface amplitude. Determination of g-mode frequencies remains highly desirable because it would help to probe the properties of the suns core. An upper limit on the surface visibility can help to impose some restraints on the possible excitation mechanisms.

Investigations with whole disk data of the GOLF and SPM instruments are restricted to time series analysis, whereas spatially resolved data from the sun, like MDI (velocity) and LOI (intensity) data, can first be treated with masks. When we are looking for g-modes, velocity data have the advantage that the dependence of the eigenfunction on the angular variables is well known without making any assumptions about the sound speed and Nyquist frequency profile of the sun, respectively. The mask providing optimal signal to noise ratio is both dependant on the mode eigenfunction and on the local noise level. To estimate the noise level, we fit a model that assumes uniformly distributed noise over the solar surface, so the varying noise across the disk is due to changing projection properties.

We find that even modes (l+m even) are easier to detect, because they have amplitude at the center of the disk where the noise is low, whereas odd modes have vanishing amplitude there. Modes below a certain (l dependant) frequency are essentially horizontal (like the noise), so they are difficult to detect, too.

Even with these optimal masks no g-modes could be detected. This leads to a root mean square displacement at 200 μHz below about 6 mm/s for even modes and below 11 mm/s for odd modes. Upper limits that low were already given, but only with the assumption of simultaneously exited multiplets. Our estimate is more conservative making no assumption at all about excitation and take into account the different visibility of the single modes making the upper limit more accurate.

VIRGO Radiometry: From raw measurements to a reliable record of Total Solar Irradiance

Claus Fröhlich

The VIRGO Experiment on the ESA/NASA SOHO Mission has two types of radiometers to measure total solar irradiance (TSI): DIARAD and PMO6V. The scientific objective of VIRGO related to TSI is to provide a reliable time series, which takes full advantage of the two types of radiometers. The final product was termed data level-2 and includes corrections for exposure dependent changes, which can be determined for each type of radiometer separately yielding data level-1.8 (see http://www.pmodwrc.ch/virgo/virgo.html), and corrections for exposure independent changes which can only be determined from a comparison of the two level-1.8 time series. To produce level-2 we have to derive a best estimate for the TSI from the two level-1.8 time-series which are different, but still within their absolute uncertainties. The procedure is described in Fröhlich (2002, Metrologia, in preparation); the result is shown in Figure 4.

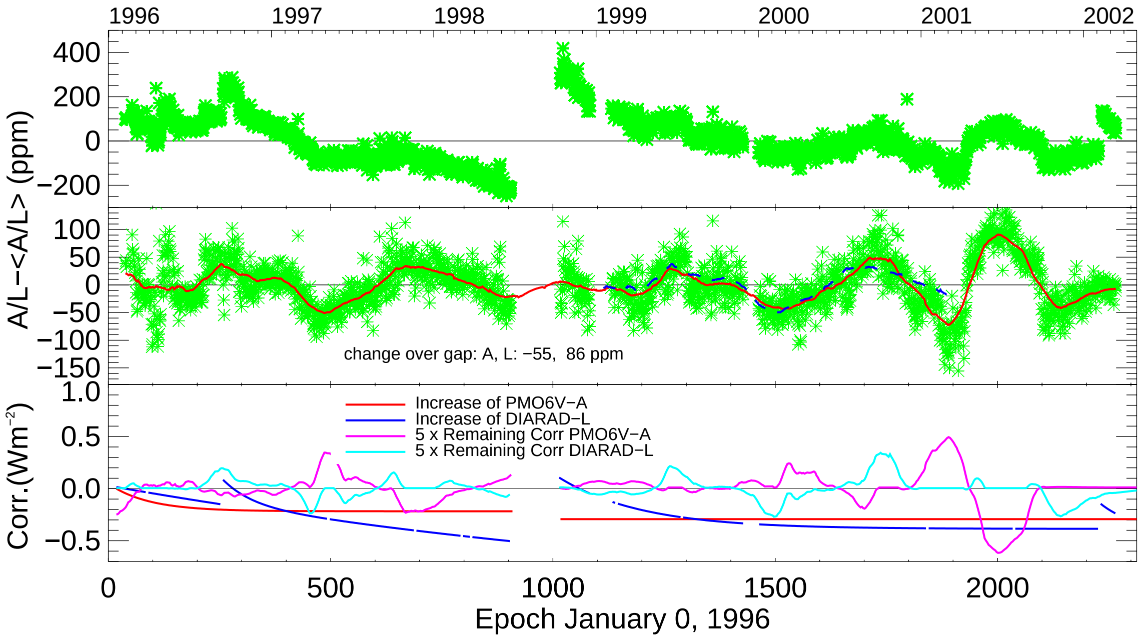

Figure 4. The top panel shows the ratio of PMO6V-A to DIARAD-L, the middle panel the deviation after applying the corrections with three exponential functions for DIARAD (1. starting after first switch-on, 2. starting after the switch-off in 1996 and 3. starting after SOHO vacations), and one for PMO6V (starting after first switch-on) These corrections are shown in the bottom panel. Also shown are the residuals which are 5 times amplified relative to the exponential functions. The share of the residuals is determined by comparison with a composite of ACRIM II and III (data version 10/10/01). The VIRGO data are version 4.902.

The Greenhouse Effect in the Alps

Rolf Philipona and Christoph Marty

The greenhouse effect has so far been investigated mainly with satellite measurements, but more than 90% of the greenhouse radiative flux affecting the Earth's surface temperature and humidity originates from a 1000 meter thick layer right above the surface. Greatly improved surface longwave radiation measurements newly allow to accurately determine the cloud radiative forcing and the greenhouse effect from the surface. Measurements at eleven radiation stations at various altitudes in the Alps were used to determine the clear-sky and all-sky annual and seasonal greenhouse effect and its altitude gradients. Longwave downward radiation in conjunction with a theoretical relation evaluated with the MODTRAN radiative transfer code allows to determine the clear-sky greenhouse effect. Longwave net radiation measurements allow to determine the longwave cloud radiative forcing. To determine the all-sky greenhouse effect the longwave cloud forcing is added to the clear-sky greenhouse effect. Large seasonal variations of the greenhouse effect and its altitude gradients demonstrate the strong coupling to surface temperature and humidity.

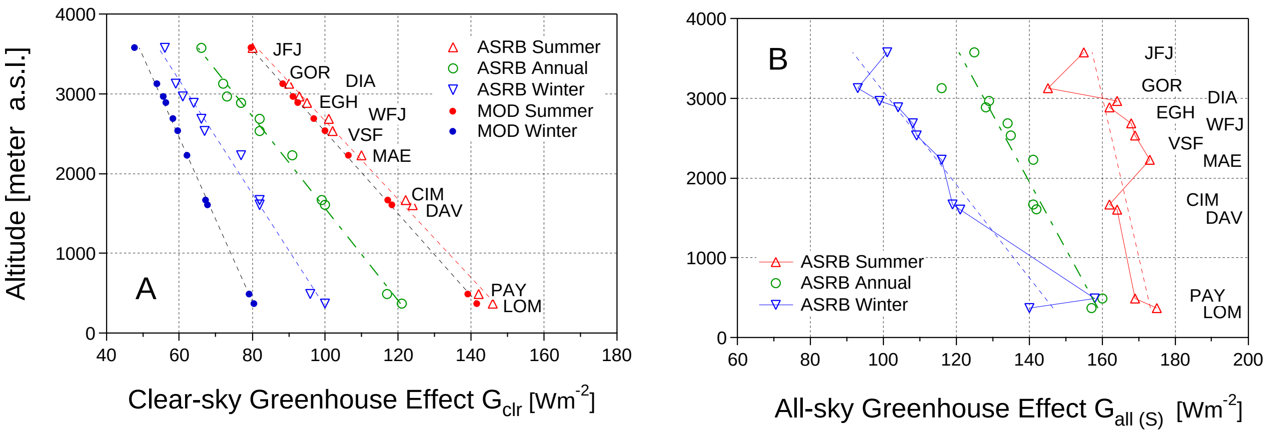

Figure 5. Annual and seasonal mean clear-sky (A) and all-sky (B) greenhouse radiative fluxes at ASRB-stations versus altitude, and MODTRAN calculated G_{clr} at ASRB altitudes using standard midlatitude summer and winter atmospheres (A). The clear-sky greenhouse effect decreases linearely with altitude, whereas the all-sky greenhouse effect is strongly affected by the cloud forcing which can be quit different at the various stations. MODTRAN calculations for clear-sky situations show similar results as ASRB measurements during summer but demonstrate a significant colder standard midlatitude winter atmosphere.

International Pyrgeometer Comparison in Alaska

Rolf Philipona

The first International Pyrgeometer and Absolute Sky-scanning Radiometer Comparison (IPASRC-I) was held at the Atmospheric Radiation Measurements (ARM) program's Southern Great Plain (SGP) site in Oklahoma in September 1999 (Philipona et al., 2001). A second, similar comparison was held at the ARM site in Barrow, Alaska, in March 2001, to test and compare longwave instruments and model calculations under arctic winter conditions. In Oklahoma, downward longwave irradiances around 300 Wm^{-2} were investigated with a total water column content between 20 and 30 mm. In Alaska, irradiances between 120 and 150 Wm^{-2}, with water content as low as 2 mm were measured. Even though the irradiance level and spectra were very different at Barrow, the agreement between pyrgeometers and measurements with the Absolute Sky-scanning Radiometer (ASR) (Philipona, 2001) were still satisfactory. However, the experiment showed that the uncertainty of pyrgeometer measurements is further reduced if a specific field calibration in the respective climate zone is applied. For such field calibrations the absolute sky-scanning radiometer, corroborated with radiative transfer model calculations, serves as important reference instrumentation.

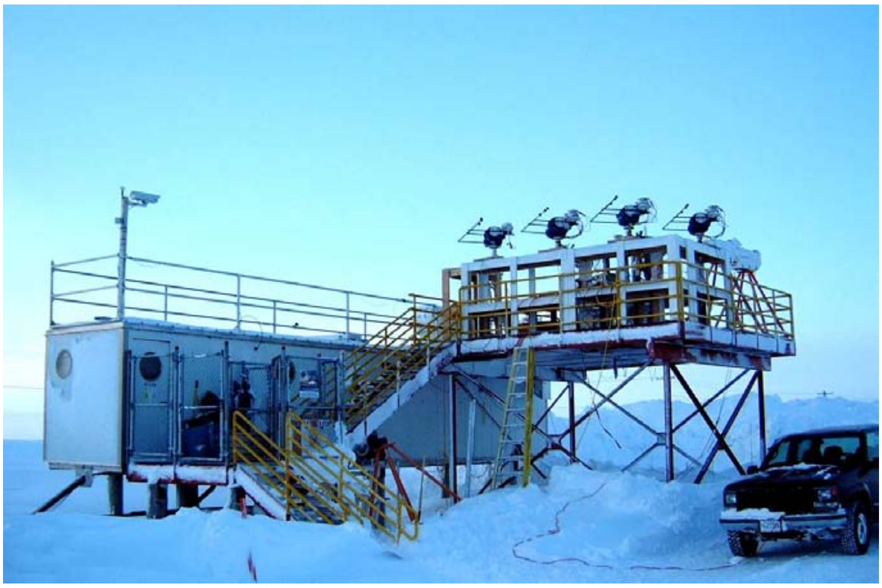

Figure 6. International Pyrgeometer and Absolute Sky-scanning Radiometer Comparison (IPASRC-II) in Barrow, Alaska, March 2001.

Comparison of ASRB data to model calculations

Bruno Dürr and Rolf Philipona

The Alpine Surface Radiation Budget (ASRB) network accurately measures the longwave downward radiation from 370 m up to 3580 m a.s.l. in the Swiss Alps (Marty et al. 2002). Therefore the ASRB observations are ideal to test radiative transfer models like MODTRAN with different atmospheric input data. Longwave downward measurements of clear-sky situations at midnight over the whole area of the ASRB network in the years 2000 and 2001 were simulated in MODTRAN applying Payerne upperair soundings and calculated vertical profiles out of the numerical weather prediction model aLMo (Alpine Model) at MeteoSwiss near the ASRB sites. We assumed that the atmosphere is laterally homogenous over the Alps for overall clear-sky situations and therefore the Payerne vertical profile is representative for the ASRB network. We additionally used air temperature, air pressure and relative humidity measured at the ASRB station as the first profile level. Figure 7 shows average differences between MODTRAN simulations - applying measured vertical profiles from Payerne - and ASRB observations to be within ±6 Wm^2 with a standard deviation of 9 Wm^{-2}. Using aLMo calculated vertical profiles the average differences lie within ±4 Wm^{-2} with a standard deviation of 5 Wm^{-2} and reasonable well agreement at high ASRB stations.

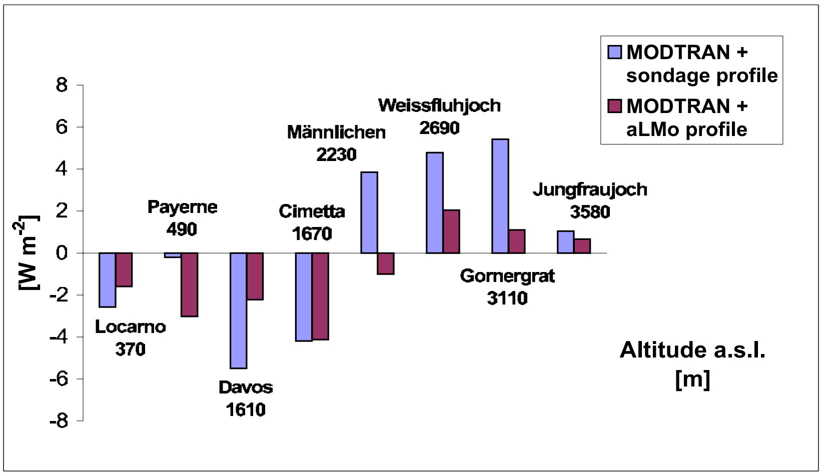

Figure 7. Average differences between MODTRAN calculated and ASRB measured longwave downward radiation of 17 clear-sky nighttime cases. Bars in light grey indicate that sondage profiles have been used for the MODTRAN calculations and dark grey bars indicate usage of aLMo profile data.

Multi year Aerosol Optical Depth at Davos

Christoph Wehrli

Aerosol optical depth or AOD is measured at Davos since more than 6 years by a 12-channel sunphotometer and used in different radiation studies at PMOD. This instrument also serves as a standard to calibrate other sunphotometers by comparison. Langley V_0-calibrations on more than 300 clear days show that most channels are stable to <0.5% and all of them to <1% per year. A simple linear interpolation of V_0 was thus used to calculate AOD and Ångström wavelength exponents α for the period from October 1995 to December 2001. Annual and overall means were calculated, assuming a normal distribution for α, and a lognormal distribution for AOD. The overall geometric mean of AOD at 500nm amounts to $0.045 \times 2.3^{\pm 1}$ optical depths and the arithmetic mean of the Ångström exponent to 1.53 ±0.4. Year to year variations of both quantities are within the overall scatter and show no significant trends.

The mean annual course of AOD is compared in Figure 8 to the turbidity derived by Ångström from total irradiance measurements at Davos between 1914 and 1926. The historic results were transformed to optical depth at 500nm via Ångström's law using his classic value for α of 1.3.

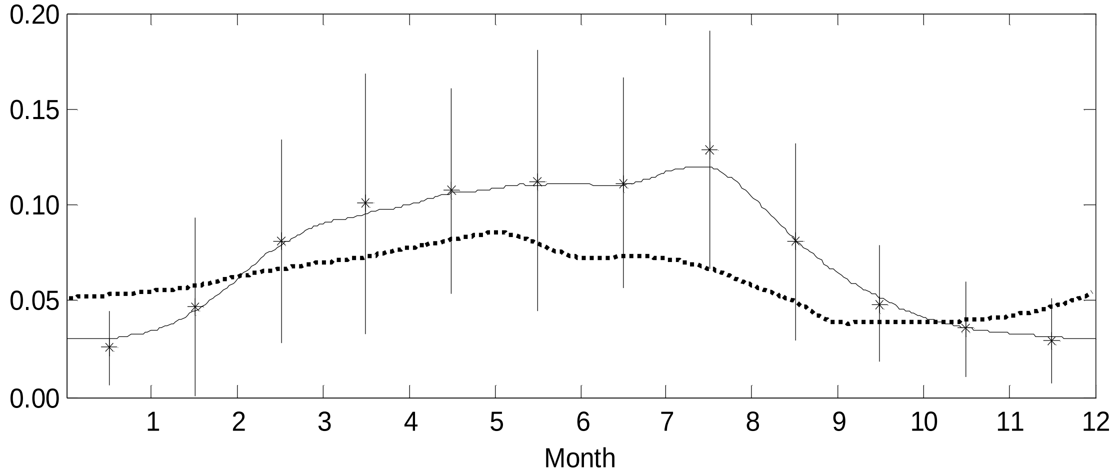

Figure 8. Daily means of AOD at 500nm for Davos from 1995 to 2001, smoothed by a running mean over 31 days (solid line), asterisks indicate monthly means with their standard deviation. Data from 1914 to 1926 are shown by dashed line. Although the historic data are within the scatter of modern measurements, they indicate clearer summer and autumn skies than are nowadays found. Note a possible selective bias: historic data were taken on sunny days, while modern results are based on continuous measurements and automated processing.

Solar Physics

Isabelle Rüedi in collaboration with A. Brkovic (ETH-Zürich), A Pauluhn (ISSI, Bern), R. Schlichenmaier (KIS, Freiburg in Breisgau) and S.K. Solanki (MPA Lindau)

Various collaborations were pursued in order to lead them to final publication of the results. All of them are based on the analysis of SOHO data sampled with different instruments and cover the following topics: heating of the penumbrae of sunspots, intercalibration of UV-spectrometers, analysis of blinker properties, variability of the quiet sun, comparison of observations and models of solar magnetic loops.

International Collaboration

The SNSF offers research grants for Scientific Collaboration between Eastern Europe and Switzerland (SCOPES). Together with scientists from the Solar Physics department at the Ulugh Beg Astronomical Institute of Uzbek Academy Science in Tashkent, Uzbekistan the PMOD/WRC submitted the project “Characteristics of Low Degree Solar Oscillations from Observations in Brightness and Velocity” to the SNSF. We received an amount of CHF 50,000 for a duration of 30 months. With this money we pay the full salaries of one staff member and three PhD students, and 50% of the salaries of three staff members.

Personnel

Scientific Personnel

PD Dr. Werner Schmutz	Physicist, director, solar physics, astrophysics, Sun-Earth connection, PI PREMOS, PI Polyproject
Dr. Claus Fröhlich	Physicist, solar variability, helioseismology, radiation budget, PI VIRGO, PI SOVIM, CoI GOLF, MDI
Dr. Rolf Philipona	Physicist, surface radiation budget, calibration of longwave instruments, IR and UV instrumentation
Dr. Eugene Rozanov	Physicist, project manager ETH-Polyproject, GCM and CTM calculations (since 1.1.2001)
Dr. Isabelle Rüedi	Physicist, absolute radiometry, solar physics, calibration of shortwave instruments, CoI VIRGO, SOVIM, PREMOS
Christoph Wehrli	Physicist, design and calibration of filter radiometers, CoI VIRGO, SOVIM, PREMOS
Bruno Dürr	PhD student ETH ZH
Margit Haberreiter	PhD student ETH-Polyproject (since 1.12.2001)
Daniel Schmucki	PhD student CUVRA (left 30.9.2001)
Richard Wachter	PhD student ETH ZH: helioseismology

Technical Personnel

Hansjörg Roth	Electronic Engineer, deputy director, head electronics dept. experiment manager VIRGO, SOVIM, PREMOS
Daniel Pfiffner	Electronic Engineer SOVIM and PREMOS
Klaus Kruse	Mechanic Engineer, computer specialist
Remo Venturi	Physics technician (left 31.5.2001)
Mario Roveretto	Technician (left 31.12.2001)
Christian Thomann	Technician (since 1.10.2001)
Jules U. Wyss	Mechanic, general mechanics, 3D design and manufacturing of mechanical parts
Danilo Dorizzi	Electronics apprentice, 4th year (left 31.7.2001)
Marcel Knupfer	Electronics apprentice, 1st year (since 1.8.2001)
Gianmarco Külbs	Electronics apprentice, 2nd/3rd year
Marcel Beyeler	Civilian Service conscript (23.4. – 28.9.2001)
Lukas Imbach	Civilian Service conscript (1.10.2001 – 31.1.2002)
Pascal Haering	Civilian Service conscript (13.11.2000 – 21.4.2001)
Thomas Gusset	Civilian Service conscript (23.4. – 25.5.2001)
Christian Thomann	Civilian Service conscript (4.12.2000 – 30.3.2001)

Administration

Sonja Degli Esposti	Administration PMOD/WRC, personnel, book keeping

Caretaker

Klara Maynard	General caretaker, cleaning
Ida Agnello	part time cleaning

Guest scientists, students

Adrian Heberlein	Student, ETH Zürich (12.2. – 23.3.2001)

Publications

Refereed articles (accepted before end 2001)

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Other Publications

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Miscellaneous Activities

Participation in Meetings and Courses

Werner Schmutz:

26.3. – 1.4.	EGS and VIRGO-Meeting, Nice, France
1.4. – 4.4.	GAW-WMO, Geneva
14.5. – 18.5.	Solar Encounter, workshop, Santa Cruz, Tenerife, Spain
13.6. – 16.6.	ISCS 2001, Longmont, USA
10.7. – 12.7.	IAMAS Conference, Innsbruck, Austria
24.9. – 25.9.	Gaining Insights into Stellar Atmospheres, workshop, Kiel, Germany

Claus Fröhlich:

21.3. – 23.3.	Aerosol Schlusspräsentation Köln, Germany
26.3. – 3.4.	EGS and VIRGO-Meeting, Nice, France
7.4. – 11.4.	G-Mode Workshop, ESTEC, Noordwijk, The Netherlands
19.5. – 25.5.	NRL Washington, SoHO SWT, USA
30.5. – 1.6.	CNES, Toulouse, France
11.6. – 20.6.	ISCS 2001, Longmont, USA
24.6. – 29.6.	Douglas Gough Meeting, Toulouse, France
6.12. – 16.12.	AGU Fall Meeting, San Francisco, USA

Rolf Philipona:

3.3. – 18.3.	IPASRC-II Pyrgeometer Comparison campaign, Barrow, Alaska
18.3. – 23.3.	ARM Science Team Meeting, Atlanta, USA
5.4.	2nd Swiss Global Change Day, ProClim, Berne, Switzerland
16.4. – 3.5.	Invited scientific exchange at UNAM, Mexico City, Mexico
9.7. – 18.7.	IAMAS Conference, Innsbruck, Austria
18. – 19.10.	SANW Yverdon
9.11.	Invited Seminar, University of Berne, Switzerland
9.12. – 14.12.	AGU Fall Meeting, San Francisco, USA

Isabelle Rüedi:

26.3. – 3.4.	EGS and VIRGO-Meeting, Nice, France

Richard Wachter:

31.3. – 2.4.	VIRGO Meeting, Nice, France
7. – 14. 5.	G-Mode Workshop, ESTEC, Noordwijk, The Netherlands
30.7. – 10.8.	CISM Summer School, Boston, USA

Christoph Wehrli:

15.7. – 18.7.	IAMAS Conference, Innsbruck, Austria
26.3. – 1.4.	EGS and VIRGO-Meeting, Nice, France
1.4. – 4.4.	GAW-WMO, Geneva

Course of Lectures, Participation in Commissions

Werner Schmutz:

- Course of lecture „Astronomy“, WS 2000/2001 and WS 2001/2002 ETHZ
- Course of lecture „Galaxies“, SS 2001, ETHZ
- Commission for Astronomy (SANW)
- Space Commission (SANW)
- Comité consultatif de photométrie et radiométrie (WMO/CCPR)
- ESO User Committee
- Examination Expert: Final Examination in Astrophysics
- GAW-CH Working Group (SMA)

Claus Fröhlich:

- Course of lecture „Strahlung und Klima“, WS 2000/2001, ETHZ
- Course of lecture „Wissenschaft im Weltraum“, WS 2000/2001, ETHZ
- Beirat Kiepenheuer Institut, Freiburg, Germany
- Working Group for Baseline Surface Radiation Network (WMO/WCRP)
- Member VIRGO Team
- SOHO Science Working Team
- WMO/GAW Aerosol SAG
- Comitée de Programm Scientifique de CNES
- Examination Expert: PhD Daniel Schmucki

Rolf Philipona
- Course of lecture “Strahlungsmessung in der Klimaforschung” WS 2000/2001 and WS 2001/2002 ETHZ
- Examination Expert: PhD Daniel Schmucki

Christoph Wehrli
- WMO/GAW Aerosol SAG
- GAW-CH Working Group (SMA)
- Member VIRGO Team

Isabelle Rüedi
- Member VIRGO Team

Hansjörg Roth
- Commission of Final Examination of apprentices
- Member VIRGO Team

Public Seminars at PMOD/WRC

28.2.2001	Spektropolarimetrie von Seyfert Galaxien	Dr. H.-M. Schmid, Heidelberg
4.7.2001	Sunspot Penumbrae – The Persuit of Structure	Daniel Müller, Uni Freiburg
19.7.2001	Are Individual Contributions to Solar Atmospheric Absorption measureable?	Dr. Bob Cahalan, NASA, USA
4.9.2001	Analysis of near-surface temperatures in high mountain permafrost environment; Study at Murtel-Corvatsch, Swiss Alps	Melanie Raymond
18.12.2001	Ultra-fine Tropical Tropopause Clouds	Prof. Dr. Th. Peter, ETH Zürich
20.12.2001	Astrologie – enthält sie ein Körnchen Wahrheit ?	PD Dr. W. Schmutz, PMOD/WRC

Guided Tours at PMOD/WRC

In 2001 we were visited by 9 groups and 5 single persons.

Abbreviations

AOD	Aerosol Optical Depth
ACRIM	Active Cavity Radiometer for Irradiance Monitoring
ACU	Attitude Control Unit
AGU	American Geophysical Union
ARM	Atmospheric Radiation Measurement
ASRB	Alpine Surface Radiation Budget, PMOD/WRC Project
ATLAS	Shuttle Mission with solar irradiance measurements
AU	Astronomical Unit (1 AU = mean Sun-Earth Distance)
AVHRR	Advanced Very High Resolution Radiometer
BAG	Bundesamt für Gesundheitswesen
BBW	Bundesamt für Bildung und Wissenschaft, Bern
BESSY	Berliner Elektronen Speicher Sychrotron
BiSON	Birmingham Solar Oscillation Network
BSRN	Baseline Surface Radiation Network of the WCRP
BUWAL	Bundesamt für Umwelt, Wald und Landschaft, Bern
CART	Cloud and Radiation Testbed
CD-ROM	Compact Disc - Read Only Memory
CHARM	Swiss (CH) Atmospheric Radiation Monitoring, CH-contribution to GAW
CIE	Commision Internationale de l′ Eclairage
CIMO	Commission for Instruments and Methods of Observation of WMO, Geneva
CIR	Compagnie Industrielle Radioélectrique, Gals
CMDL	Climate Monitoring and Diagnostik Laboratory
CNES	Centre National d'Etudes Spatiales, Paris, F
CNRS	Centre National de la Recherche Scientifique, Service d`Aeronomie Paris
CoI	Co-Investigator of an Experiment/Instrument/Project
COSPAR	Commission of Space Application and Research of ICSU, Paris, F
CPD	Course Pointing Device
CSEM	Centre Suisse de l'Electro-Mécanique, Neuenburg
CTM	Chemical Transport Model
CUVRA	Characteristics of the UV radiation field in the Alps
DIARAD	Dual Irradiance Absolute Radiometer of IRMB
DLR	Deutsche Luft und Raumfahrt
EDT	Eastern daylight saving Time
EGS	European Geophysical Society
EGSE	Electrical Ground Support Equipment
EISLF	Eidgenössisches Institut für Schnee- und Lawinenforschung, Davos
ENET	supplementary meteorological network of SMA
ERBS	Earth Radiation Budget Satellite
ERS	Emergency Sun Reacquisition
ESA	European Space Agency, Paris, F
ESO	European Southern Observatory
ESOC	European Space Operations and Control Centre, Darmstadt, D
ESTEC	European Space Research and Technology Centre, Noordwijk, NL
ETH	Eidgenössische Technische Hochschule (Z: Zürich, L: Lausanne)
EURECA	European Retrievable Carrier, flown August 1992 - Juni 1993 with SOVA Experiment
EUV	Extreme Ultraviolet Radiation
FDE	Fault Detection Electronics
FWHM	Full width half maximum (e.g. filtertransmission)
GAW	Global Atmosphere Watch, an observational program of WMO
GCM	General Circulation Model
GIETHZ	Geographisches Institut ETHZ
GOLF	Global Oscillations at Low Frequencies= experiment on SOHO
GONG	Global Oscillations Network Group
GSFC	Goddard Space Flight Center, Maryland, USA
HECaR	High sensitivity Electrically Calibrated Radiometer
HF	Hickey-Frieden Radiometer manufactured by Eppley, Newport, R.I., USA

HP	Hewlett Packard
HST	Hubble Space Telescope
IAC	Instituto de Astrofísica de Canarias, Tenerife, E
IAD	Ion assisted deposition of thin dielectric layers
IAMAS	International Association of Meteorology and Atmospheric Sciences of IUGG
IAS	Institut d'Astrophysique Spatiale, Verrières-le-Buisson, F
IASB	Institut d'Aéronomie Spatiale de Belgique, Bruxelles, B
IAU	International Astronomical Union of ICSU, Paris, F
IFU	Institut für Umweltwissenschaften, Garmisch-Partenkirchen
ICSU	International Council of Scientific Unions, Paris, F
IDL	Interactive Data-analysis Language
IKI	Institute for Space Research, Moscow, Russia
INTRA	Intelligent Tracker from BRUSAG
IPASRC	International Pyrgeometer and Absolute Sky-scanning Radiometer Comparison
IPC	International Pyrheliometer Comparisons
IPHIR	Inter Planetary Helioseismology by Irradiance Measurements
IR	Infrared
IRMB	Institut Royal Météorologique de Belgique, Brüssel, B
IRS	International Radiation Symposium of the Radiation Commission of IAMAS
ISA	Initial Sun Acquisition
ISS	International Space Station
ISSA	International Space Station Alpha (NASA, ESA, Russland, Japan)
IUGG	International Union of Geodesy and Geophysics of ISCU
JPL	Jet Propulsion Laboratory, Pasadena, California, USA
KrAO	Crimean Astrophysical Observatory, Ukraine
LASCO	Large Angle and Spectrometric Coronagraph
LOI	Luminosity Oscillation Imager, Instrument in VIRGO
MDI	see SOI/MDI
MODTRAN	Moderate Resolution Transmission Code (in Fortran)
NASA	National Aeronautics and Space Administration, Washington, USA
NIMBUS7	NOAA Research Satellite, launched Nov.78
NIP	Normal Incidence Pyrheliometer
NOAA	National Oceanographic and Atmospheric Administration, Washington, USA
NPL	National Physical Laboratory, Teddington, UK
NRL	Naval Research Laboratory, Washington, USA
NREL	National Renewable Energy Lab
NTT	New Technology Telescope
OCAN	Observatoire de la Côte d'Azur, Nice, F
PC	Personal Computer
PCSR	Planck Calibrated Sky Radiometer
PFR	Precision Filter Radiometer
PHOBOS	Russian Space Mission to the Martyan Satellite Phobos
PI	Principle Investigator, Leader of an Experiment/Instrument/Project
PICARD	French space experiment to measure the solar diameter (launch 2005)
PIR	Precision Infrared Pyrgeometer von Eppley
PMOD	Physikalisch-Meteorologisches Observatorium Davos
PMO6-V	VIRGO PMO6 type radiometer
PREMOS	Precision Monitoring of Solar Variability, PMOD experiment on PICARD
PRODEX	Programme for the Development of Experiments der ESA
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig & Berlin, D
RA	Regional Association der WMO
RASTA	Radiometer für die Automatische Station der SMA
SANW	Schweizerische Akademie der Naturwissenschaften, Bern
SARR	Space Absolute Radiometer Reference
SLF	Schnee und Lawinenforschungsinstitut, Davos
SFI	Schweiz. Forschungsinstitut für Hochgebirgsklima und Medizin, Davos
SGP	Southern Great Plane
SIAF	Schweiz. Institut für Allergie- und Asthma-Forschung, Davos
SIMBA	Solar Irradiance Monitoring from Balloons

SMM	Solar Maximum Mission Satellite of NASA
SNF	Schweizer. Nationalfonds zur Förderung der wissenschaftlichen Forschung
SNSF	Swiss National Science Foundation
SOCOL	Combined GCM and CTM computer model
SOHO	Solar and Heliospheric Observatory, Space Mission of ESA/NASA
SOI/MDI	Solar Oscillation Imager/Michelson Doppler Imager, Experiment on SOHO
SOJA	Solar Oscillation Experiment for the Russian Mars-96 Mission
SOL-ACES	Solar Auto-Calibrating EUV/UV Spectrometer for the International Space Station Alpha by IPM, Freiburg i.Br., Germany
SOLERS22	Solar Electromagnetic Radiation Study for Solar Cycle 22, of STEP, ISCU
SOLSPEC	Solar Spectrum Instrument for the International Space Station Alpha by Service d'Aeronomie, Verriere-le-Buisson, France
SOVA	Solar Variability Experiment on EURECA
SOVIM	Solar Variability and Irradiance Monitoring for the International Space Station Alpha by PMOD/WRC Davos, Switzerland
SPC	Science Programme Committee, ESA
SPM	Sonnenphotometer
SPP-U	Schwerpunktsprogramm Umwelt des SNF
SRB	Surface Radiation Budget
SSD	Space Science Department of ESA at ESTEC, Noordwijk, NL
STEP	Solar Terrestrial Energy Program of SCOSTEP/ICSU
STUK	Finish Center for Radiation and Nuclear Safety
SUMER	Solar Ultraviolet Measurements of Emitted Radiation
SW	Short Wave
SWT	Science Working Team
TSI	Total Solar Irradiance
UARS	Upper Atmosphere Research Satellite of NASA
UCL	University College London
UCLA	University of California Los Angeles
UKIRT	United Kingdom Infrared Telescope
USA	United States of America
UTC	Universal Time Coordinated
UV	Ultraviolet radiation
VIRGO	Variability of solar Irradiance and Gravity Oscillations, Experiment on SOHO
VLT	Very Large Telescope
WCRP	World Climate Research Programme
WMO	World Meteorological Organization, Geneva
WORCC	World Optical Depth Research and Calibration Center (since 1996 at PMOD)
WRC	World Radiation Center
WRR	World Radiometric Reference
WSG	World Standard Group

Donation (Ernst Göhner Stiftung, Zug)

Donation for extraordinary investments: total CHF 100,000. In the year 2000 the PMOD/WRC bought a 3-D CAD system for CHF 33,000 and in 2001 we purchased a laser and a climatic test cabinet for CHF 20,000 and CHF 41,000, respectively. The remaining CHF 6000 were used for a new accounting software.

Rechnung PMOD/WRC 2001
Allgemeiner Betrieb PMOD/WRC (exkl. Drittmittel)

Ertrag

Bund, Betrieb WRC	798’000.00
Bund, WORCC	152’000.00
Kanton Graubünden	134'989.95
Landschaft Davos	202'484.90
Landschaft Davos, Mieterlass	133'500.00
Zuweisung Stiftung	190'000.00
Instrumentenverkauf	127'479.05
Bundesamt für Gesundheit	25'000.00
Div. Einnahmen, Eichungen	68'200.05
Aktivzinsen	13'165.35
Beitrag Göhner Stiftung	67'384.85
Total 2001	1'912'204.15

Aufwand

Gehälter	1'053'042.57
Sozialleistungen	270'984.20
Investitionen	110'512.90
Unterhalt Apparate	14'428.90
Verbrauchsmaterial	100'057.11
Reisen und Kongresse	56'526.63
Bibliothek und Literatur	26'814.05
Raumkosten	181'545.75
Verwaltungskosten	95'736.17
Total	1'909'648.28
Ergebnis 2001	2'555.87
	1'912'204.15

Bilanz PMOD/WRC (exkl. Drittmittel)

Aktiven	31.12.2001	31.12.2000
Kassa	1’028.60	1’678.60
Postcheck	20’300.04	18’825.19
Bankkonten	611’293.75	617’998.28
Debitoren	109’177.90	43’591.55
Verrechnungssteuer	7’656.45	2’567.35
Kontokorrent Mitarbeiter	-3’718.45	-976.20
Kontokorrent SNF	68’429.95	37’592.70
Kontokorrent SNF-2	11’113.30	
Kontokorrent PREMOS	45’071.35	
Kontokorrent SOVIM	56’296.85	128’417.69
Kontokorrent Poly-Projekt	5’405.25	
Kontokorrent SoHO-11	800.00	
Warenlager		50’000.00
Transitorische Aktiven	2’429.10	3’142.65
Total Aktiven	935’284.09	902’837.81

Passiven	31.12.2001	31.12.2000
Kreditoren	56’316.55	48’111.84
Kontokorrent Stiftung	45’069.40	116’833.65
Transitorische Passiven	438’940.55	359’790.60
Rückstellungen	278'489.05	264'189.05
Eigenkapital	116'468.54	113'912.67
Total Passiven	935'284.09	902'837.81