Jahresbericht 2002

Physikalisch-Meteorologisches Observatorium Davos
World Radiation Center

Annual Report 2002

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SFI

Schweizerisches Forschungsinstitut für Hochgebirgsklima und Medizin

DAVOS

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Zusammenfassung Jahresbericht 2002

Vorwort

Das PMOD/WRC organisierte im März 2002 das SOHO 11 Symposium im Davoser Kongresszentrum. Es trafen sich die Benutzer des ESA/NASA Forschungs-Satelliten SOHO, auf dem auch das Davoser Experiment VIRGO seit Anfangs 1996 die Sonnenstrahlung misst. Dank der grossen internationalen Beteiligung war das Symposium wissenschaftlich ein voller Erfolg und da sich auch das Wetter von seiner prächtigsten Seite zeigte, mit tiefblauen Himmel und verschneiten Bergen, waren auch die Rahmenbedingungen für die Teilnehmer optimal. Meines Erachtens hat sich auch für das PMOD/WRC der Aufwand gelohnt, da die gelungene reibungslose Durchführung beste Werbung für die Schweiz im Allgemeinen und im Speziellen für den Tourismus Ort Davos war und indirekt auch Werbung für die Davoser Messinstrumente. Dass diese Werbewirkung nicht nur Wunschdenken ist, können wir mit einer direkten Auswirkung eines SOHO 11 Kontaktes nachweisen. Ein Tagungsteilnehmer vom Belgischen Königlichen Observatorium, Jean-François Hochedez, mit dem wir während der Tagung die neuesten Forschungsresultate unseres ETH-Polyprojektes diskutiert haben, hat das PMOD/WRC danach angefragt, ob es die Hardware für ein Technologie-Weltraumexperiment bauen könne, bei der neuentwickelte Diamantdetektoren für ultraviolette Strahlung auf ihre Weltraumtauglichkeit getestet werden sollen. Der entsprechende Antrag wurde im Juli eingereicht und das Experiment LYRA (Lyman α Radiometer) wurde für die ESA Technologie Mission PROBA 2 ausgewählt, die ab Ende 2004 für zwei Jahre die UV Strahlung der Sonne messen soll. Im vergangenen Dezember hat auch das Schweizerische PRODEX Programm Komitee die Zustimmung zur PMOD/WRC Beteiligung gegeben.

Die Zusammenarbeit des PMOD/WRC mit der ETH Zürich ist seit Jahren problemlos und für beide Parteien lohnend. Nun hat die ETH mir den Titel eines ETH Professors verliehen. Die Ernennung erfolgte zwar in erster Linie aufgrund meiner wissenschaftlichen Arbeit, aber der Titel wird nur an Personen verliehen, die auch eine Beziehung zur ETH aufweisen können. Die Verleihung bedeutet daher auch eine Anerkennung der Zusammenarbeit durch die ETH. Ich fühle mich durch diese Auszeichnung

geehrt und hoffe, dass unsere Beziehung zur ETH auch weiterhin erfreulich verläuft.

Die MeteoSchweiz und das SFI haben Ende 2001 die finanzielle Grundlage geschaffen, um ein Kalibrierzentrum für Messgeräte der atmosphärischen Infrarotstrahlung aufzubauen. Diese Vorleistung ist durch zwei Kommissionen der Weltmeteorologischen Organisation (WMO), diejenige für Instrumente und Beobachtungsmethoden (CIMO-XIII) und die für Atmosphärenwissenschaften (CAS-XIII), anerkannt worden, indem die darin vertretenen Experten die Einrichtung eines solchen Zentrums am PMOD/WRC empfohlen haben. Die WMO hat der führenden Rolle des PMOD/WRC auf dem Gebiet der Messungen von Infrarotstrahlung auch durch die Verleihung des „Vaisala“ Preises an Rolf Philipona Ausdruck gegeben. Der PMOD/WRC Wissenschaftler erhielt den Preis für seine Veröffentlichung zur Entwicklung eines Referenzgerätes zur Messung von IR Strahlung. Die Errichtung eines Infrarot-Radiometer Kalibrierzentrums am PMOD/WRC ist noch nicht vollständig gesichert, da noch nicht alle Parteien der Finanzierung eines solchen Zentrums ab 2004 zugestimmt haben. Das Vorhaben erscheint nun aber immerhin realisierbar, da der wichtigste Partner, der Bund, durch einen Bundesratsbeschluss in der letzten Sitzung von Frau Bundesrätin Dreifuss auf Antrag ihres Departements Ende Dezember 2002 seine Zustimmung gegeben hat. Ich hoffe, dass ich in einem Jahr an dieser Stelle über die erfolgreiche Einrichtung des Zentrums berichten kann.

Dienstleistungen und Messnetze

Das PMOD/WRC kalibrierte für 14 Auftraggeber 66 Instrumente. Diese Anzahl Aufträge entspricht in etwa dem überdurchschnittlichen Auftragsvolumen des letzten Jahres, womit die Nachfrage nach unserer Grunddienstleistung als Weltstrahlungszentrum erfreulich hoch blieb.

Um das PMOD/WRC auf die angestrebte Erweiterung unserer WMO-Dienstleistungen bezüglich eines Infrarot-Radiometer Kalibrierzentrum vorzubereiten, wurden verschiedene Standorte für Messinstrumente umgestellt und erweitert. Insbesondere wurden die ersten zwei Pyrgeometer einer zukünftigen Pyrgeometer-Standardgruppe in Betrieb

genommen. Zusätzlich zu den fest am PMOD/WRC installierten Instrumenten wurde eine mobile Einheit gebaut, mit der Messgeräte vor Ort kalibriert werden können, womit vermieden wird, dass diese von ihrem Einsatzort entfernt werden müssen. Diese mobile Messeinheit wurde in einem ersten Einsatz erfolgreich als autarke Messstation während einer Messkampagne im Frühsommer 2002 am Nordpol eingesetzt.

Das GAW-Versuchsmessnetz zur Überwachung der Trübung durch Aerosol Teilchen ist um die Station Sverdrup in Spitzbergen erweitert worden. Damit sind nun PMOD/WRC Präzisions-Filterradiometer an acht Stationen weltweit und an zwei Schweizer Stationen im Dauerbetrieb. Die Archivierungsprozedur der Messdaten ist mit den Werten von Hohenpeissenberg getestet worden, die ans Datenzentrum in Ispra gesandt wurden. Das endgültige Datenformat wird festgelegt, wenn mit der Archivierung der Testdaten genügend Erfahrung gesammelt wurde. Das Ziel ist, dass alle PFR Daten ausgewertet und kontrolliert in der Form von Trübungswerten nach Ispra geschickt werden und weltweit den Meteorologen zugänglich sind.

Das Messnetz des Alpine Surface Radiation Budget (ASRB) Projekts bestand seit 1996 aus elf Stationen und ist nun um die Station auf Les Diablerets reduziert worden. Bei der Les Diablerets Station gab es in der Vergangenheit verschiedene technische Probleme, die längere Unterbrüche in der Messreihe verursachten. Zudem sind die Les Diablerets Daten mit denjenigen der Stationen Eggishorn und Gornergrat vergleichbar und daher ist der Informationsgehalt von Les Diablerets redundant. Die ASRB Station in Davos wurde umstrukturiert: Bisher wurde die einfallende Strahlung auf dem Dach des Observatoriums gemessen und die von der Erde emittierte Strahlung auf dem Windmast der MetoSchweiz beim Davoser See. In der Nähe des Observatoriums ist ein Mast neu aufgestellt worden, auf dem nun beide Strahlungsrichtungen am gleichen Ort erfasst werden.

Entwicklung und Bau von Instrumenten

Die Entwicklung der PMO6-cc war im Wesentlichen schon im Jahr 2001 abgeschlossen. Es wurden daher im letzten Jahr nur noch Änderungen zur

Optimierung der Regelung des Messvorgangs vorgenommen. Als Vorbereitung für den Bau einer weiteren Serie von PMO6-cc wurden zwei neue Prototypen gebaut, die nun getestet werden.

Zur Förderung des Verkaufs der PMO6-cc Pyrheliometer und zur Reduzierung des Aufwands für das PMOD/WRC Personal wurde mit der Firma Kipp & Zonen in Holland im Mai 2002 ein Verkaufsabkommen geschlossen. Im letzten Jahr wurde vor dem Abkommen ein PMO6-cc nach Frankreich verkauft und drei Geräte sind über Kipp & Zonen abgesetzt worden.

Weltraumexperimente VIRGO, SOVIM, PICARD und LYRA

Das PMOD/WRC Experiment VIRGO auf dem Satelliten SOHO läuft weiterhin ohne nennenswerte Störungen und liefert Messwerte der Sonnenstrahlung. Die SOHO/VIRGO Messreihe umfasst nun über sieben Jahre. Das nächste PMOD/WRC Weltraumexperiment zur Erfassung der Sonnenstrahlung, SOVIM, soll im Juni 2003 zur Integration abgeliefert werden. Im Verlauf des Jahres 2002 sind die verschiedenen Komponenten durch uns und unsere Industriepartner Contraves und BRUSAG gefertigt und die Elektronik zum Einbau vorbereitet worden. SOVIM hätte 2004 auf der Internationalen Raumstation installiert werden sollen. Durch den Absturz der Raumfähre Columbia ist vorauszusehen, dass der vorgesehene Zeitplan kaum eingehalten werden kann. Allerdings ist noch nicht bekannt wie lange das Experiment verzögert wird.

Das Konzept des Filterradiometer-Experiments PREMOS, das ein Bestandteil der französischen Mission PICARD ist, wurde im Berichtsjahr überarbeitet. Die wesentlichste Änderung betrifft das elektrische Interface mit dem Satelliten, das an neue Anforderungen angepasst werden musste. Der Datenaustausch erfolgt neu über eine RS422 Schnittstelle, was nun wesentlich höhere Anforderungen an die PREMOS Elektronik stellt. Eine Änderung war auch für den Verschlussmechanismus der Instrumenten-deckel erforderlich. Der bis jetzt vorgesehene Zugmagnet, der eine höhere elektrische Leistung erforderte, als vom Satelliten zur Verfügung gestellt werden kann, wird durch einen stromsparenden Parafin-Aktuator ersetzt. Ansonsten schreitet die Entwicklung von PICARD nur langsam voran, da

die französische Raumfahrtsagentur das Projekt verzögert, um die Finanzierung über mehrere Jahre verteilen zu können.

Das Konzept für PREMOS konnte mit nur wenigen Modifikationen auch für ein neu vorgeschlagenes Filterradiometer Experiment übernommen werden. Unter der Führung des Königlichen Belgischen Observatoriums haben wir bei der ESA ein Experiment zur Messung der Ultraviolett-Strahlung der Sonne auf dem geplanten Technologiesatelliten PROBA 2 eingereicht. Da die Beobachtungen vor allem der prominenten Lyman α Emissionslinie gelten, tauften wir das Experiment Lyman α Radiometer (LYRA). Unser Vorschlag wurde von der ESA zur Ausführung ausgewählt und auch das Schweizerische PRODEX Programm Komitee hat dem Bau des schweizerischen Beitrags zugestimmt. Es bedarf aber noch der Gutheissung der entsprechenden belgischen Stelle, bevor sichergestellt ist, dass das Experiment gebaut werden kann.

ETH-Polyprojekt „Variabilität der Sonne und Globales Klima“

Das ETH-Polyprojekt ist eine Zusammenarbeit mit den ETH Instituten für Astronomie und Klimawissenschaften unter der Leitung des PMOD/WRC. Das Ziel des Projekts ist es, den vermuteten Einfluss der variablen Sonnenstrahlung auf das Erdklima zu erforschen. Etwas vereinfacht formuliert, mussten im ersten Teil des Projektes verschiedene Computer-programme für unsere Zielsetzungen abgeändert oder neu erstellt werden. Diese Phase ist im vergangenen Jahr weitgehend abgeschlossen worden. Die ersten Rechnungen wurden so gewählt, dass man die Resultate entweder mit Beobachtungen oder mit anderen Rechnungen vergleichen konnte. Naturgemäss liefern Verifikations-Rechnungen wenig spektakuläre Resultate. Aber immerhin: unser neues Programm SOCOL (Solar-Climate-Ozone-Link – auch der russische Name für Falke) konnte erfolgreich die Bildung des Ozonlochs über dem Südpol simulieren, was für uns bedeutet, dass unser Programm die wesentlichen atmosphärischen Prozesse, die wir untersuchen wollen, hinreichend gut behandelt.

Erste wirkliche Resultate des Projektes betreffen die Reaktion der Erdatmosphäre auf die variable UV Einstrahlung, wie sie in den letzten Jahren von Spektrographen des UARS Satelliten gemessen wurde. Unsere

Rechnungen reagieren mit einer Erwärmung der Stratosphäre aufgrund erhöhter UV Einstrahlung. Dieser Effekt ist nicht überraschend, da er einer direkten Reaktion auf die erhöhte UV Bestrahlung entspricht. Überraschend ist hingegen, wie die tieferen Schichten auf diese Änderung reagieren: durch nichtlineare Effekte erwärmt sich auch die Mesosphäre und die Reaktionskette pflanzt sich weiter fort, um am Schluss auch Bodenschichten zu erwärmen. Das Programm berechnet erhöhte Oberflächen-Lufttemperaturen über den USA, Sibirien und Nordeuropa von bis zu 2.5 K im Durchschnitt und eine Abkühlung über dem Kaspischen Meer und Nordkanada von bis zu 3 K. Diese Signale auf der Erdoberfläche sind im Vergleich zur Ursache unerwartet gross und im Moment sind die numerischen Resultate auch noch nicht verstanden. Unsere Resultate müssen daher noch weiter untersucht und bestätigt werden aber potentiell haben wir ein aufsehenerregendes Resultat in Griffnähe.

Untersuchungen von Pyranometer Instrumentenfehler

Pyranometer werden eingesetzt um sowohl die globale Strahlung inklusive der direkten Sonnenstrahlung zu messen als auch die diffuse Strahlung, indem das Instrument durch vor die Sonne plazierte Scheiben von der direkten Bestrahlung abgeschattet wird. Da die diffuse Strahlung sehr viel geringer ist als die direkte bzw. die globale Strahlung, wirken sich Offsetfehler der Instrumente bei der Messung der globalen bzw. diffusen Strahlung verschieden stark aus. Bei der Kalibrierung der Geräte muss daher die gewünschte Einsatzart bekannt sein. Der Offset-Instrumentenfehler kann entweder bei der Kalibriermethode berücksichtigt oder – wie eine Untersuchung zeigt – mit konditionierten Geräten, die ventiliert und beheizt sind, vermieden werden.

Registrierung von Perioden mit klarem Himmel

Wenn Temperatur, Feuchte und Infrarot-Einstrahlung an einer meteorologischen Station gemessen werden, kann aus diesen Messgrössen bestimmt werden, ob der Himmel klar oder bedeckt war. Die Methode zur Bestimmung des Bedeckungsgrads aus automatisch gemessenen Grössen konnte verbessert werden, indem nicht nur die

momentanen Messgrössen berücksichtigt werden, sondern auch der zeitliche Verlauf der Temperatur.

Vergleich der Atmosphärischen Verhältnisse auf Jungfraujoch und Mauna Loa

Um Filterradiometer mit Hilfe der Sonnenstrahlung zu kalibrieren, extrapoliert man die gemessene Strahlung als Funktion der Sonnenhöhe auf den Wert der extraterrestrischen Sonneneinstrahlung, die innerhalb der angestrebten Genauigkeit der Kalibrierung als konstant betrachtet werden kann. Die Methode bedingt, dass zumindest über einen halben Tag die atmosphärische Transmission konstant bleiben muss. Standorte, die solche Bedingungen bieten und die auch mit vernünftigem Aufwand zugänglich sind, sind selbst weltweit rar. In Europa ist das Jungfraujoch der beste Kalibrierstandort, weltweit gilt der Mauna Loa auf Hawaii als der beste Ort. Da PFR Instrumente des GAW Messnetzes sowohl auf dem Jungfraujoch als auch auf dem Mauna Loa eingesetzt werden, können aufgrund deren Messresultate die beiden Standorte verglichen werden. Es zeigt sich, dass Mauna Loa seinem Ruf gerecht wird und in der Tat die wesentlich besseren Kalibrierbedingungen bietet als das Jungfraujoch.

Internationale Zusammenarbeit

Das PMOD/WRC kollaboriert mit Sonnenphysikern des Ulugh Beg Astronomischen Institutes in Taschkent, Usbekistan, in einer Analyse der von unseren Weltraumexperimenten beobachteten Sonnenoszillationen. Das Projekt ist vom Schweizerische Nationalfonds durch einen speziellen Fonds Namens SCOPES (Scientific Collaboration between Eastern Europe and Switzerland) finanziert. Im Berichtsjahr hat unser Doktorand Richard Wachter zur engeren Zusammenarbeit fast vier Wochen in Usbekistan verbracht und für das laufende Jahr ist ein Gegenbesuch eines Taschkenter Wissenschaftlers geplant. Das Projekt läuft noch bis Ende 2003.

Im Rahmen eines INTAS (International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union) Projekts der EU koordiniert das PMOD/WRC eine

Zusammenarbeit mit den Instituten Arctic and Antarctic Research Institute und Main Geophysical Observatory in St. Petersburg, sowie mit dem Max Planck Institut für Aeronomie in Deutschland. In dem gemeinsamen Projekt soll der Einfluss des Sonnenwinds auf die Erdatmosphäre untersucht werden.

Infrastruktur

Das Bundesamt für Bauten und Logistik hat im Jahr 2002 den Umbau der Elektronikabteilung finanziert. Die Labors sind nun mit einem leitenden und geerdeten Boden ausgestattet. Dies war eine schon lange ausstehende Verbesserung der Laborinfrastruktur, die verhindert, dass elektrostatische Entladungen teure Elektronikkomponenten zerstören (was tatsächlich schon vorgekommen ist). Zugleich wurde auch die Raumaufteilung verbessert und einer der Laborräume in ein Einzelbüro sowie in ein Labor für die Elektroniklehrlinge aufgeteilt.

Lehrverpflichtungen

An der ETH Zürich wurden folgende Vorlesungen gehalten: W. Schmutz hielt im Wintersemester 2001/2002 die Vorlesung „Astronomie“ an der ETH Zürich und im Wintersemester 2002/2003 die gleiche Vorlesung gemeinsam mit PD Dr. H. M. Schmid. R. Philipona las in den Wintersemestern 2001/2002 und 2002/2003 an der ETH Zürich die Vorlesung „Strahlungsmessung in der Klimaforschung“.

Personelles

Im Verlauf des letzten Jahres konnten zwei Laborantenstellen neu besetzt werden. Mit dem Jahresanfang 2002 begann Marcel Spescha am PMOD/WRC seine Tätigkeit und für den Physiklaboranten Ursin Solèr, der frisch von seiner Ausbildung an der EMPA zu uns kam, war offizieller Arbeitsbeginn am 1. September 2002. Allerdings musste er erst die Rekrutenschule beenden und daher war der tatsächliche Arbeitsbeginn erst im Oktober. Damit beschäftigt das PMOD/WRC insgesamt drei Laboranten. Dieser Ausbau des Laborbereichs wurde möglich, da Klaus Kruse, der die Informatik-Bedürfnisse des Observatoriums betreute, uns per Ende Oktober

2002 nach mehr als 5 Jahren verliess. Das PMOD/WRC dankt Klaus Kruse für seinen Einsatz, wobei man insbesondere die Informatik-Betreuung während des SOHO 11 Symposiums hervorheben darf, da diese Tagungswoche besonders lange Arbeitstage erforderte.

Wiederum ist es gelungen ETH Doktoranden für PMOD/WRC Projekte ans Observatorium zu holen. Es sind Chris Hoyle und Marcel Sutter neu zu uns gestossen und da letztes Jahr kein Doktorand abgeschlossen hat, sind es nun sechs Doktorierende, die am PMOD/WRC arbeiten. Meines Erachtens bringen diese jungen Leute, zusammen mit unseren Zivildienstleistenden und den Lehrlingen, eine wohltuend unbekümmert-junge Atmosphäre ans Observatorium.

Leider hat Gianmarco Külbs im dritten Jahr seine Ausbildung als Elektroniker aufgegeben. An seine Stelle ist Christian Gubser als Erstjahrs-Lehrling zu uns gestossen.

Das vierte Jahr Zivildienst am PMOD/WRC wäre beinnahe das letzte geworden, da zukünftig Forschung in der Schweiz kein Zivildienst Einsatzbereich mehr sein wird. Dank unserem guten Ruf als Einsatzbetrieb und unserer Einsatzrichtung, die auch mit Umweltschutz in Zusammenhang gebracht werden kann, bekam das PMOD/WRC von Bundesrat Couchepin auf Anfrage von Nationalrätin Gadient die Erlaubnis, auch weiterhin Zivildienstler einsetzen zu können. Es ist nicht übertrieben zu sagen, dass die sieben Zivildienstleistenden, die bei uns im 2002 im Einsatz waren, mit ihrem vielfältigen Erfahrungshintergrund ausserordentlich nützliche Arbeit geleistet haben und dadurch dem Observatorium eine im wahrsten Sinn des Wortes wertvolle Unterstützung waren.

Vom 4. 11. bis 13. 12. 2002 verbesserte unsere Administratorin ihre Englisch Kenntnisse an der Wimbledon School of English in London – und schloss erfolgreich mit dem Certificate in Advanced English ab. Ich gratuliere Sonja Degli Esposti zu diesem schönen Erfolg.

Der Leiter der Infrarot und UV Gruppe, Rolf Philipona habilitierte sich an der ETH Zürich. Ich gratuliere ihm zum ehrenvollen Titel als Privatdozent.

Sponsoren

Herr Daniel Karbacher aus Küsnach (ZH) hat dem PMOD/WRC einen grösseren Geldbetrag geschenkt. Letztes Jahr haben wir aus diesen Mitteln eine Sonnennachführung für den Kalibrierplatz der Pyranometer angeschafft. Diese Sonnennachführung dient dazu Pyranometer abzuschatten, wenn diese die diffuse Strahlung messen sollen. Bis anhin hatten wir nur die Möglichkeit ein einziges Pyranometer abzuschatten und zudem war die alte Nachführung mechanisch unzuverlässig geworden. Die neue Vorrichtung erlaubt es nun 5 Pyranometer gleichzeitig zu betreiben, bzw. zu kalibrieren.

Der Förderverein hat die Anschaffung eines EMC Testgeräts ermöglicht. Zur Ausmessung der Störsicherheit von Elektronik Baugruppen ist ein EMC Test unerlässlich. Bis anhin hat man sich mit dem Ein- und Ausschalten von elektrischen Geräten in der Nähe des Testobjekts beholfen. Das EMC Testgerät erlaubt nun mit definierten elektromagnetischen Störungen auf die Elektronik einzuwirken, um die Störungssensibilität festzustellen.

Dank

Die wichtigste Unterstützung des PMOD/WRC wurde im vergangenen Jahr von der MeteoSchweiz geleistet. Die Finanzierung des Weltstrahlungszentrums muss periodisch erneuert werden und der neue Vertrag ist auf Anfang 2004 fällig. Antragstellerin beim Bund für die Finanzierung des WRC ist die MeteoSchweiz und die an vorderster Stelle involvierten Personen, Herr G. Müller, Präsident der Aufsichtskommission und Vizedirektor der MeteoSchweiz, Herr D. Keuerleber, Direktor der MeteoSchweiz und Herr P. Morscher, Chef der Finanzabteilung, haben sich engagiert und erfolgreich beim Bund für das PMOD/WRC eingesetzt – sie haben sich unseren aufrichtigen Dank verdient. Natürlich gilt mein Dank auch den übrigen Mitgliedern der Aufsichtskommission sowie dem Stiftungsrats-Ausschuss, die auch zur Antragstellung beigetragen haben.

Nachdem wir in den Jahren 2000 und 2001 dank dem Beitrag der Ernst Göhner Stiftung zusätzliche Investitionen vornehmen konnten, waren es im Jahr 2002 ein Geschenk einer Privatperson, Herr Daniel Karbacher aus

Küsnacht, und die Unterstützung des Fördervereins, die uns erlaubten ausserhalb des Budgets dringende Investitionen zu tätigen. Vielen Dank für diese Sonderbeiträge!

Für die stets wohlwollende Förderung danke ich den kommunalen und kantonalen Behörden sowie dem Schweizerischen Nationalfonds, der ETH Zürich und dem PRODEX Programm für die Finanzierung unserer Forschungsprojekte. Der ausgeglichene Jahresabschluss war aber wiederum, wie letztes Jahr, das Verdienst der PMOD/WRC Mitarbeiter. Dank dem Überschuss aus Instrumentenverkauf und Kalibrierungen konnte eine budgetierte Auflösung von Rückstellungen vermieden werden. Ich bedanke mich bei allen für Ihren Einsatz und Beitrag zum Observatoriums-betrieb.

Frau Nationalrätin Gadient verdient für ihre Bemühungen um den Erhalt des Zivildienstes am PMOD/WRC unser herzliches Dankeschön.

Davos, im April 2003 Werner Schmutz, Professor Dr. sc. nat.

Annual Report 2002

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Introduction

Werner Schmutz

In March 2002 the PMOD/WRC organized and hosted the SOHO 11 symposium at the Davos congress center. This conference was attended by a large number of international participants who engaged in scientific discussions regarding the analysis and interpretation of data obtained with the ESA/NASA satellite SOHO. PMOD/WRC has a strong interest in SOHO, as the satellite incorporates the VIRGO instrument, which was built in Davos. VIRGO has been actively measuring solar radiation levels since the beginning of 1996. With white mountains and blue skies, the weather conditions for the conference were perfect, and all involved came away with feeling that the meeting was a complete success. Despite the enormous effort involved in hosting such a meeting and ensuring that it runs smoothly, I feel that it is worthwhile, as such a conference provides an excellent opportunity to advertise the PMOD/WRC itself, the Davos area, and Switzerland in general. The symposium also provided opportunities for fostering future collaborations. As an example of this, Dr. Jean-François Hochedez approached the PMOD/WRC after the meeting to inquire whether we might consider building the hardware for an experiment in which he intends to test new diamond detectors for their qualification in space applications. Dr. Hochedez's experiment proposal was accepted for the ESA technology mission PROBA 2 that is planned to fly at the end of 2004. In December 2002 the Swiss PRODEX program committee approved the financial funding for the Swiss contribution.

At the end of 2001, MeteoSwiss and the foundation SFI contributed to the preparatory investments for needed for a planned Infrared Radiometer Calibration Center in Davos at the PMOD/WRC. Experts from two commissions of the World Meteorological Organization (the commission for instruments and methods of observations, CIMO-XIII, and the commission for atmospheric sciences, CAS-XIII) had recommended the establishment of such a center at the PMOD/WRC. Underlining the good reputation of the observatory regarding its engagement in IR radiation research, Dr. Rolf Philipona of our institute was the recipient of the "Vaisala award" from the

WMO for his publication on an infrared radiometer that can be used as reference instrument. Despite these investments and recommendations, the establishment of an infrared radiometer calibration center at PMOD/WRC is not yet certain as approval of the financial means is still pending from some of the supporters involved. Nevertheless, it appears the program will go forward, since the Swiss federation (the largest financial contributor) did approve the funding last December at the request of the department of minister Mrs. Dreifuss. I hope I will be able to report on the establishment of the new center in a years' time in the next annual report.

On a more personal note, I have been awarded the title of Honorary Professor at the ETH in Zürich. I feel very honored by the recognition from the ETH and hope that the relationship between the ETH and the PMOD/WRC can continue to grow and develop in such a positive manner as it has in the past.

Operational Services

Calibrations

Isabelle Rüedi, Rolf Philipona, Christian Thomann, and Christoph Wehrli

As World Radiation Center 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 six 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 64 sunny days 6 absolute radiometers, 8 pyrheliometers and 33 pyranometers were calibrated with the Sun as source and the WSG as reference. These instruments belong to 14 independent institutions.

With a black-body radiation source we calibrated 22 pyrgeometers. On the roof platform of the observatory all pyrgeometers were additionally field

compared to a group of standard pyrgeometers that are traced to IPASRC calibrations and the absolute sky-scanning radiometer.

For customers and use in the GAW network we have calibrated three Precision Filter Radiometers (PFR) in the PMOD/WRC laboratory and outside, with the Sun as radiation source. As routine, the standard instruments of the GAW network, PFR N-01 and N-26, were calibrated twice with a trap detector to monitor their stability.

Infrared Radiometer Calibration Center – Preparation Phase I

Rolf Philipona

At present the radiometric reference for longwave radiation measurements is based on the PMOD/WRC Absolute Sky-scanning Radiometer (ASR). The ASR was compared to pyrgeometer measurements, to Atmospheric Emitted Radiance Interferometer (AERI) measurements and to radiative transfer model calculations during two International Pyrgeometer and Absolute Sky-scanning Radiometer Comparisons (IPASRC-I and IPASRC-II). Pyrgeometers are precalibrated in the PMOD/WRC blackbody calibration apparatus in the laboratory. The final calibration is made on the roof platform of the observatory, where pyrgeometers are field compared to a group of standard pyrgeometers. At present this standard group consists of an Eppley PIR pyrgeometer and a Kipp & Zonen CG4 pyrgeometer, but more instruments will be added in the future. The two instruments were thoroughly calibrated during the two IPASRC campaigns and are traced to ASR measurements made at Davos. In the near future more space will be needed on the roof platform to allow to field calibrate several pyrgeometers simultaneously. Therefore, the Davos ASRB station had to be moved to a new location in front of the Observatory (see “The ASRB network”). A new logger had to be purchased for the new station.

In order to be able to calibrate and to compare pyrgeometer and pyranometer measurements at ASRB or BSRN stations, two CG4 pyrgeometers and two CM22 pyranometers were acquired to build a traveling standard instrument. A tripod allows positioning of the instruments two

meters above ground and a logger system as well as temperature and humidity sensors make this traveling standard a stand-alone unit. This unit has first been used during a measuring campaign at the North Pole (see “Surface Radiation Measurements at North Pole”) and is presently installed at Summit station in Greenland.

GAW Trial Network

Christoph Wehrli

A PFR system was installed at the Sverdrup station on Spitzbergen and operated by the Norwegian Institute for Air Research (NILU). Data were collected during the arctic summer from May through September when the instrument was sent back to Davos for recalibration. Good measurements of AOD were obtained, sometimes over 24 hours, but clear-sky conditions were found for less than 10% of the possible time during the summer months. Laboratory characterizations of the instrument have determined a slight change of sensitivity in the UV channels that was confirmed by comparison with our standard instruments. The PFR will resume measurements at Ny Ålesund in spring 2003.

With the stations at Ryori and Alice Springs delivering data since April 2002, the network now comprises eight worldwide and one Swiss stations that are operating without major problems. Hourly mean values of AOD from Hohenpeissenberg were generated and successfully submitted to the World Data Center for Aerosols in Ispra in order to test an extension of the NARSTO protocol to accommodate optical depth data. The preparation of automatic tools to facilitate the transfer of further datasets is planned.

Several new data acquisition units for PFR instruments were built as substitutes for devices in permanent use on Jungfraujoch and at Davos.
An overview of GAW network was given in a talk during the 7th BSRN scientific workshop in Regina, Canada, and a statistical study on high-altitude calibrations presented as poster at the 182nd Annual Meeting of the Swiss Academy of Science in Davos. (see later in this report)

After the last remaining instruments were sold to national meteorological institutes in Germany and Finland, PFR instruments are no longer offered by the PMOD/WRC.

The ASRB Network

Rolf Philipona and Bruno Dürr

The eleven stations of the Alpine Surface Radiation Budget (ASRB) network were built between 1994 and 1996. Six ASRB stations came online end of 1994 and four stations during 1995. The last station, Payerne, which is collocated with the Swiss BSRN station, was installed in spring 1996. During the eight years period all ASRB stations were field calibrated twice. Modifications on two ASRB stations had to be done in 2002. First, the station Les Diablerets was discontinued this fall. On the one hand technical problems on the station and important modifications at the site caused several long-term interruptions. On the other hand, the altitude of Les Diablerets is similar to that of Eggishorn and Gornergrat and is therefore, with regard to the altitude profile, which has been thoroughly investigated, not that important anymore. Second, the station Davos had to be relocated. In the past the incoming fluxes were measured on the roof of the observatory, while the outgoing fluxes were measured at the MeteoSwiss wind mast close to lake Davos. Both incoming and outgoing fluxes are now measured at a new station on a small hill in front of the observatory, close to the temperature and humidity measurements of the MeteoSwiss ANETZ network.

Instrument Development / Sales

Commercial Radiometer PMO6-cc

Isabelle Rüedi, Hansjörg Roth, Daniel Pfiffner, Marcel Spescha, and Jules Wyss

Four complete PMO6-cc radiometers were sold, one to a French company and three to Kipp and Zonen, Holland.

In May 2002 an agreement has been signed between PMOD/WRC and Kipp & Zonen, the well-known producer of radiation measuring instruments.

Kipp & Zonen was allocated the exclusive right to sell PMO6-cc radiometers in exchange for promoting the radiometers.

Last year it appeared that an individual adjusting of each unit was necessary. The origin of this problem was found during the year and the situation is now much more satisfactory.

Two PMO6 radiometer heads were built in preparation for the manufacturing of a new instrument series and to gain experience for the development of the next radiometer generation.

Future Space Experiment SOVIM

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

The Solar Variability Irradiance Monitor (SOVIM) is an experiment to measure the total and spectral solar irradiance. During 2002 most of the flight hardware has been manufactured. The mechanical design is finished with all its parts manufactured and the surface treatment being done. Those instruments that are built by PMOD/WRC have been finished and tested and presently, they are being calibrated. The assembling and wiring of the data acquisition electronics and the computer units has been accomplished and successfully tested. The on-board flight software has been completed and it is now tested at Alenia to check the communication and the correctness of the data transfer. It was planned to install the experiment on the International Space Station in 2004. However, as a consequence of the crash of the space shuttle Columbia, most probably a delay is expected, but so far no new schedule has been announced.

Future Space Experiment PREMOS

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

PREMOS is a Swiss contribution to the French micro satellite mission PICARD. PREMOS is a four channel filter radiometer with optical and UV channels. Because of new requirements the interface to the spacecraft had to be changed fundamentally. The communication is new through a RS422 interface. As the cover locking mechanism, originally designed using a

magnet, needed more power than could be supplied by the satellite, there is now a solution using paraffin actuators.

Future Space Experiment LYRA

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

LYRA is a proposition of the Royal Belgian Observatory (ROB) and has been selected by ESA for the technology demonstration mission PROBA 2. LYRA will monitor the Sun for its Lyman α irradiance at 121.6 nm and in three additional selected wavelength bands in the UV. It will be the first space assessment of the novel UV detectors from the BOLD (Blind to Optical Light Detectors) program of ROB. The PMOD/WRC contributes the hardware except for the detectors. The design for LYRA has been copied from PREMOS. Thus, the LYRA experiment is a four-channel filter radiometer with three identical instruments in order to assess sensitivity changes of the detectors and filter elements. The Swiss PRODEX Program Committee has approved the Swiss participation in the experiment, but the Belgian commitment is still pending.

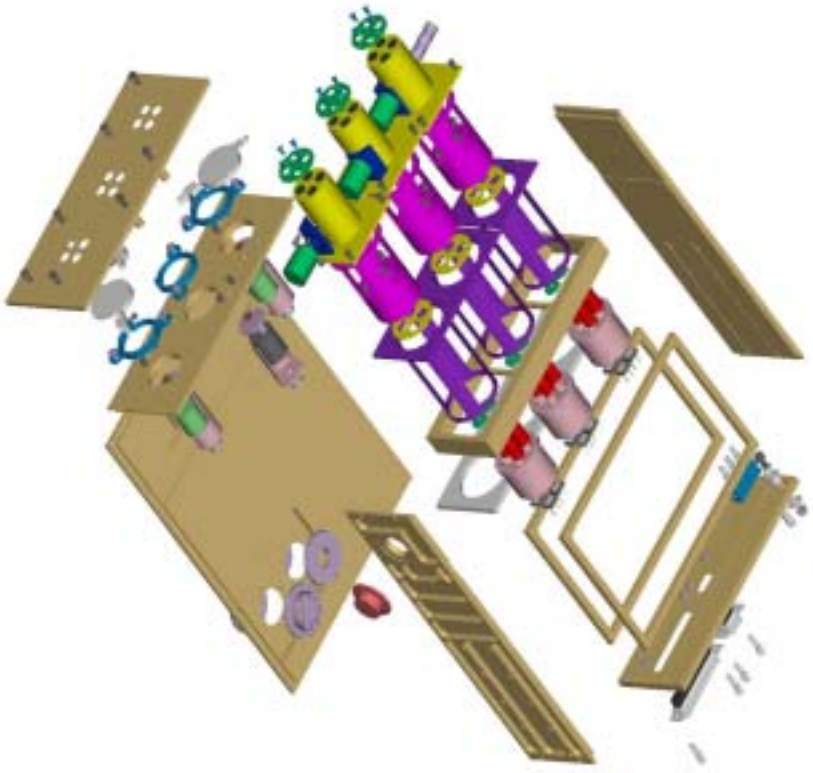

Figure 1. Exploded view of the LYRA experiment. The elements are from top to bottom: radiation shields, cover mechanisms, field stops, shutters, mufflers, precision apertures, filters, detectors, and electronic compartment (empty frames).

Design of a New Generation Radiometer for Future Space Experiments

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

We proposed the *D*avos *O*bservatory *Rad*iometer *E*xperiment (DORADE) for the Solar Dynamics Observatory (SDO) mission. DORADE measures the Total Solar Irradiance (TSI) and consists of a new-generation radiometer and a pair of reliable, space-proven PMO6-V radiometers. The new-generation PMO-PS type radiometer has four active cavities. All four cavities are directed toward the front of the instrument in a highly symmetrical arrangement. The heat sink is common to all cavities, and each cavity has its own stepper motor operated shutter. Thus, any cavity can be used for solar measurements and any pair of cavities can be operated as an independent radiometer. This arrangement was originally proposed by Crommelinck for the CROM type radiometers and has the advantage that both the measuring and reference cavities face the same thermal environment, which was not the case in the traditional PMO6-V design. For the operation the phase sensitive detection at the fundamental shutter frequency, which was first proposed for the operation of TIM radiometer on the NASA SORCE mission and reduces the influences of e.g. the non-equivalence substantially. This operation gives the new instrument its name: PMO-PS, with ‘PS’ standing for ‘phase sensitive’. The PMO-PS radiometer will have an increased absolute accuracy mainly due to the reduction of the influence of the non-equivalence between electrical and radiative heating.

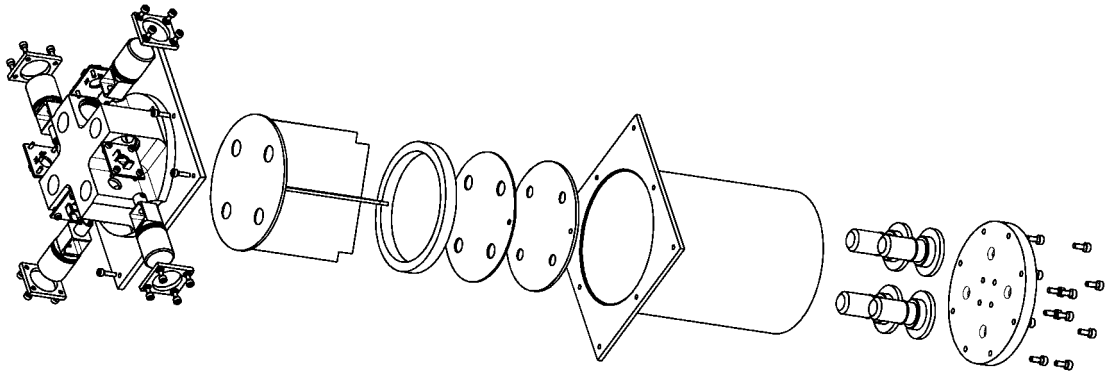

Figure 2. Exploded view of the PMO-PS absolute radiometer.

Scientific Research Activities

ETH-Polyproject – Variability of the Sun and Global Climate

Overview

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

The PMOD/WRC leads the multi-institutional ETH-Polyproject “Variability of the Sun and Global Climate” supported by the Swiss Federal Institute of Technology. We are studying the influence of the short-term and long-term solar irradiance variability on the global chemistry and climate from the mesopause down to the Earth's surface. The aim of the project is to advance the understanding of the Sun-Earth connection.

During 2002 we have completed the development of the computer code SOCOL (General Circulation and Chemistry Model tool for evaluations of *S***o**lar-*C*limate-*O*zone *L*inks) and updated our parameterization of the heterogeneous chemistry and the solar heating due to ozone and oxygen absorption. We have carried out two 20-year-long steady-state simulations in a fully coupled mode to calculate the distribution of the temperature, winds and atmospheric species. For these two simulations we used the observed solar spectral energy distributions for the maximum and minimum of the solar activity cycle from 1992 to 1999. These experiments allowed us to validate the model performance against observational data and to elucidate the model response to the imposed solar UV flux enhancement.

We have also gathered all necessary input data for the evaluation of the atmospheric response to the solar flux variability during the 28-day solar rotation cycle. For the intended transient simulations of the atmosphere during the satellite monitoring era (1978-2000) we will need to reconstruct solar UV fluxes at least for the pre-UARS period of time (1978-1991). To do so we intend to apply our non-LTE spherical radiation transfer code COSI. Its updating has almost been completed during 2002 and the validation of the code is illustrated below. To calculate the UV radiation for 1978-1992 we intend to use the distribution of the active areas on the Sun as reconstructed from Kitt Peak magnetograms.

Modeling of the Global Climate and Ozone

Eugene Rozanov and Tatiana Egorova

The temperature, zonal wind and species distributions simulated with SOCOL have been compared with available observational data. Figure 3 (left panel) illustrates the comparison of the simulated total ozone with satellite observations. The position and magnitude of the “ozone hole” is well reproduced by the SOCOL, implying that the amount of PSC during the cold season and the ozone destruction are reasonably well captured by the updated chemical routine of the model. The position of the total ozone maximum in the Australian sector is also well captured, however the magnitude of the maximum is slightly underestimated. Figure 3 (right panel) represents a comparison of the simulated and observed zonal mean temperature for December. SOCOL reproduces well the main observed features of the temperature distribution. The deviation of the simulations from the observations is less than 5K in the troposphere/stratosphere and there are no significant cold biases in the model. The simulation of the winds (not shown) is also rather satisfactory.

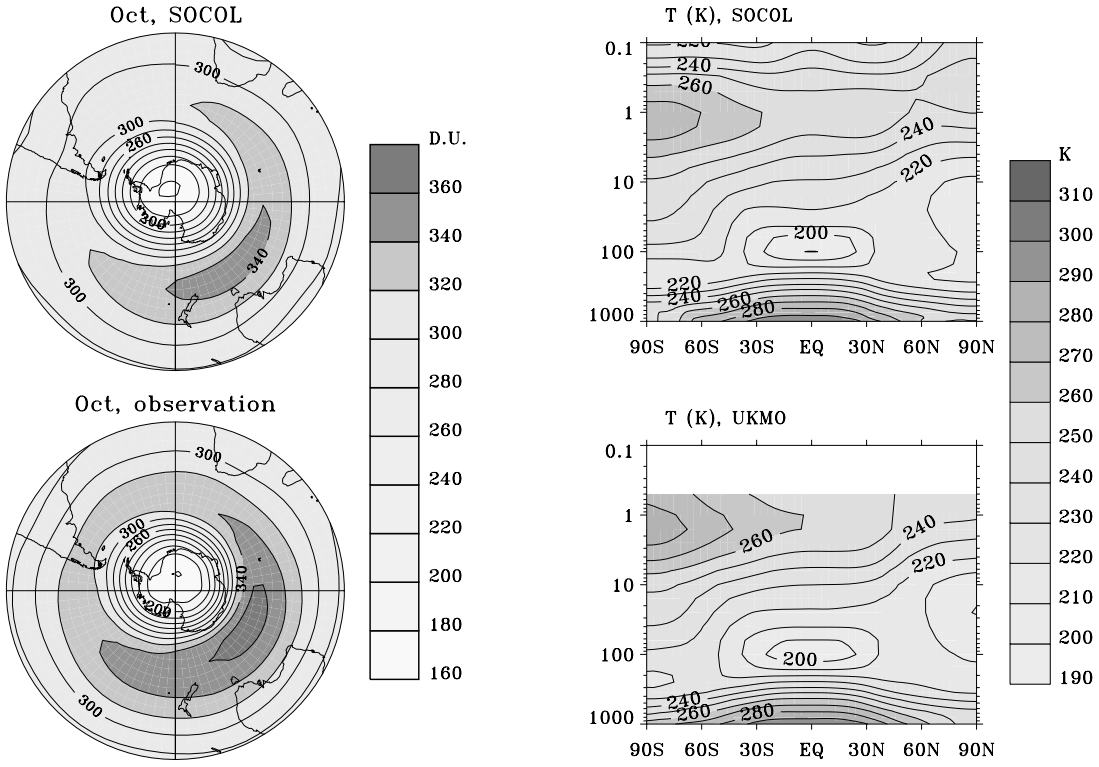

Figure 3. Comparison of the SOCOL-simulated total ozone (Dobson Units [DU]) for October over the Southern Hemisphere (left plate) and zonal mean temperature (T [K]) for December (right plate) with observations.

Global Ozone and Climate Response to the UV Enhancement During the Solar Activity Cycle

Eugene Rozanov and Tatiana Egorova

Figure 4 (left panel) illustrates the annual mean changes of ozone (%) and temperature (K) due to the increase of the solar irradiance from minimum to maximum of the 11-year solar cycle. We have obtained a theoretically expected ozone increase in the stratosphere and ozone decrease in the mesosphere as a result of the enhanced HO_x production. Due to more intensive heating the stratosphere warms by up to 1.2K in the tropics. The mesosphere warms up by up to 2K over the southern high latitudes and over the tropics due to the solar irradiance increase. Figure 4 (right panel) shows the solar signal in the surface temperature and geopotential height (GPH) at 25 hPa level. Changes in GPH are positive over the Pacific and negative over Northern Russia and North America, reproducing the observed response for the northern winters during easterly QBO phase. Our results also reveal a statistically significant warming of the surface air by up to 2.5K over the USA, Siberia, and Northern Europe, and cooling by up to 3K over the Caspian See and Northern Canada.

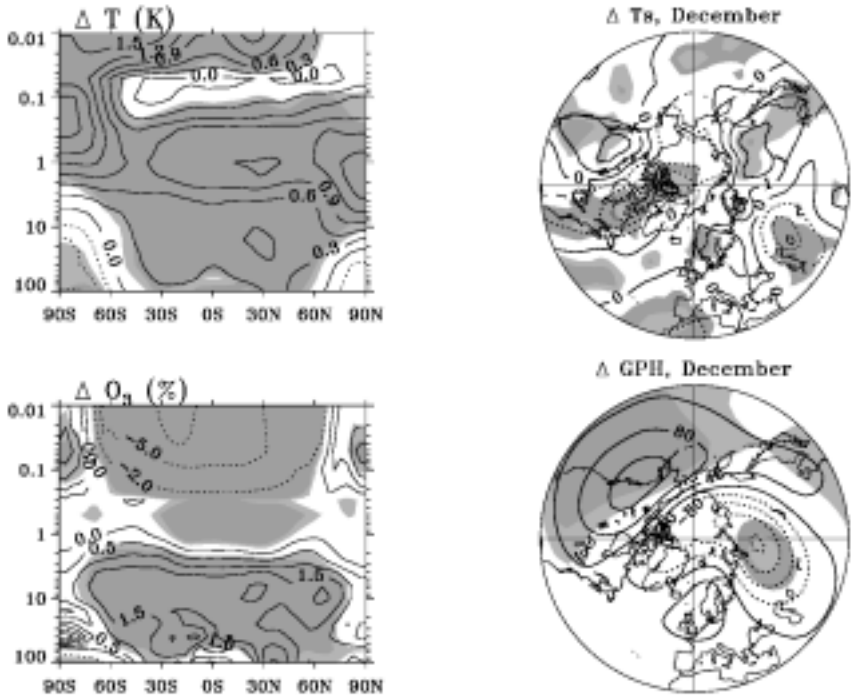

Figure 4. Annual mean cross sections (left) and geographical distribution (right) of the solar signal in temperature difference (K), ozone (%), and GPH (m) fields. The shaded area indicate that the signal is statistically significant at the 95% confidence level.

Validation of the Radiative Transport Model COSI

Margit Haberreiter, Eugene Rozanov, and Werner Schmutz

Due to the strong influence of the UV radiation on the terrestrial stratosphere, we are investigating the solar variability from 100 to 300 nm. For this purpose we apply the code COSI (*Co*de for *S*olar *I*rradiance), which allows us to calculate the continuum and line formation for layers in the solar photosphere that are not in local thermodynamic equilibrium (non-LTE). This is especially important for the wavelength range shorter than 200 nm. For the reproduction of the solar spectrum, we implemented the latest theoretical photoionization cross sections of the lower atomic levels of the most abundant elements in the Sun (H, He, C, Mg, Al, Si, Fe). To validate our code, we then calculated synthetic solar spectra in LTE and compared it with synthetic solar spectra predicted by the ATLAS9 code developed by Kurucz, which is also calculated with the assumption of LTE (Figure 5). The overall agreement between these spectra assures the correct performance of our COSI code. The slight differences in the UV can be explained by fact that we used the latest photoionization cross sections, in contrast to older atomic data in the Kurucz code. Future steps in this sub-project within the ETH-Polyproject will be the calculation of synthetic non-LTE solar UV spectra, their comparison with the observational data and the reconstruction of the UV variability on the basis of magnetograms.

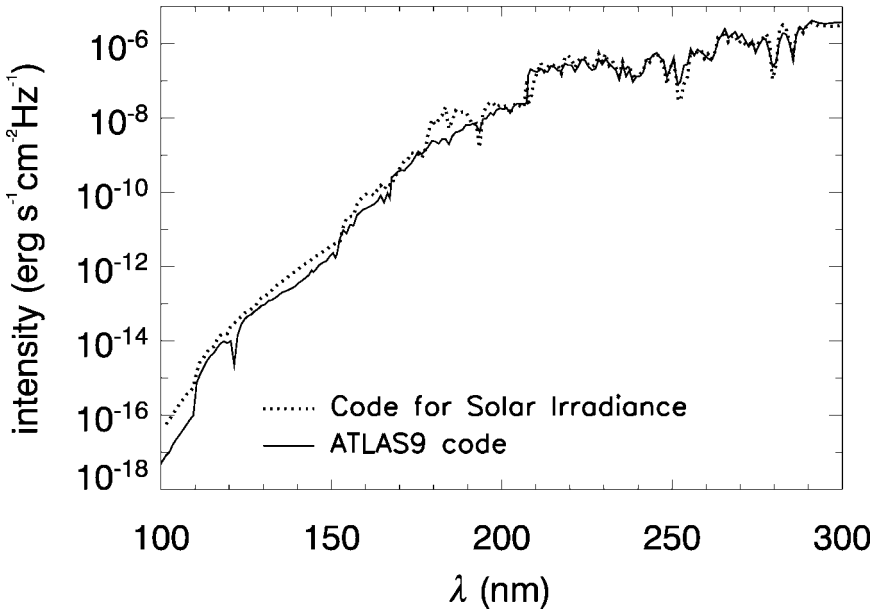

Figure 5. Comparison of synthetic solar spectra calculated in LTE. The solid line represents the spectrum calculated with the ATLAS9 code and the dotted line denotes the spectrum calculated with COSI. The good agreement between the two synthetic spectra demonstrates that the most important physical processes are taken into account by COSI.

Modeling the Instantaneous Lifetimes of Ozone Depleting Substances

Chris Hoyle, Tatiana Egorova, Eugene Rozanov

Under the leadership of Prof. T. Peter, IACETH, the PMOD/WRC participates in an ETH TH-project "3-D model study of the ozone depleting substances lifetime and its dependence on the state of the atmospheric general circulation". We simulate the evolution of atmospheric chemical species during the last several decades, using our Chemistry-Transport model "MEZON", which is driven by the UKMO reanalysis data. Our aim is to improve the understanding of the life cycle of the ozone depleting substances in the atmosphere and their dependence on the state of atmospheric general circulation. We calculated the instantaneous lifetimes of several ozone depleting substances (ODS) for the period 1993-2002 and found variations of the order of 50% in the monthly mean instantaneous lifetimes of the longer-lived ODS when compared to the average lifetime of the same species for the period simulated. Between 1993 and 2002 the model also suggests a general decrease in the annual mean lifetimes of the ODS and N_2O (see Figure 6). As the main sink of the longer-lived ODS is photolysis in the stratosphere, the variation in lifetimes is likely to be related to vertical transport in the stratosphere. Therefore, we intend to investigate the link between the fluctuations in instantaneous lifetimes and variability in circulation patterns. We will also determine if the variations in circulation given by the UKMO data which drives our model are realistic.

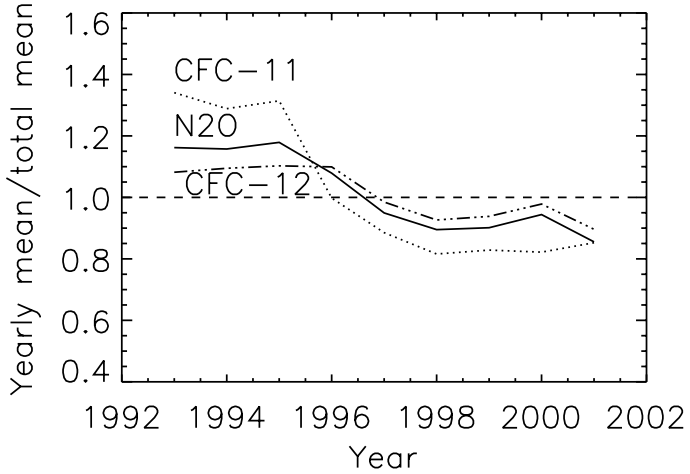

Figure 6. Deviation of yearly mean instantaneous lifetime of CFC-11, CFC-12 and N_2O from total mean life time.

Inferring Source Properties for the Excitation of p Modes form Pseudo Mode Spectra

Richard Wachter, Claus Fröhlich, and Werner Schmutz

The theory of excitation of sound waves and more specifically, solar p modes in the Sun has been further developed. It is generally accepted that the sound waves on the Sun are excited by turbulent convection. The way by which turbulent convection couples with the acoustic cavity is determined by the thermodynamic conditions, as well as the exact location. P modes are trapped by a acoustic potential well of finite height, which has its peak slightly below the photosphere of the sun. Above a certain frequency, the so-called 'acoustic cutoff frequency', the modes are no longer trapped, but only partially reflected by the acoustic potential. Thus, the structure of the spectrum above the acoustic cutoff frequency is determined by the so-called pseudo modes (Figure 7). Therefore, the source becomes more and more important in this frequency range.

The location of the source influences the helioseismic spectra in many different ways. It has been shown from numerical solutions of the wave equation, that the asymmetry of p-mode line profiles is sensitive to the source location, as well as the properties of the so-called pseudo-mode spectrum. These pseudo-modes still feel some influence of the acoustic potential well, so that they are partially reflected. This provides further and independent information for the location of the source.

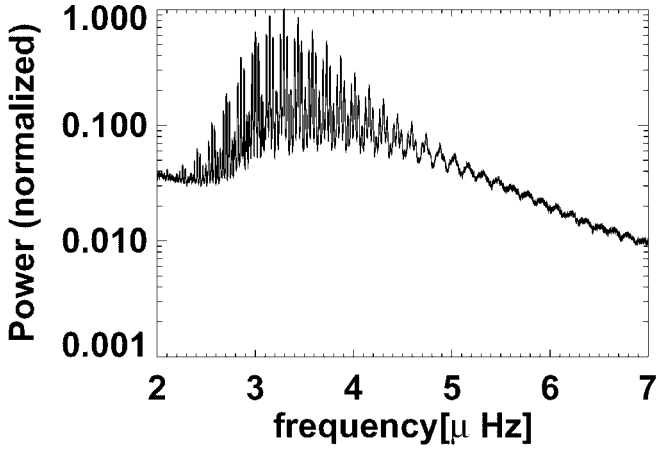

Figure 7. Observed power of solar oscillations. The p modes are the dominant signal in the frequency range from 2 mHz to 5.2 mHz. The structure above this frequency band is believed to be caused by the so called pseudo modes. The transition between modes and pseudo modes is smooth.

Does the Solar Irradiance Show a Secular Trend over the Last 20 Years ?

Claus Fröhlich

Since the publication of Willson in 1997 the question whether the total solar irradiance (TSI) has a secular trend is controversial. A recent revised version of the ACRIM composite by Willson and Mordvinov shows an even larger difference of almost 0.7 Wm^{-2} between the two minima of 1985/87 and 1996/97. The composite of Fröhlich and Lean (1998), called by Willson, the PMOD composite, contrasts these findings and the most recent version (25_06_0302) shows a difference of -0.07 Wm^{-2}, which is not significantly different from zero. The major difference between the two composites is a correction of the NIMBUS/HF data during the 2.5-year gap between ACRIM-I and II, which is ignored by Willson. Already in 1995 the ERBS team has proposed such a correction with 0.6 Wm^{-2}, deduced from comparison of the NIMBUS/HF data with their ERBS results.

A comparison of the two composite versions with the ERBS record is shown in Figure 8. It is quite obvious that a correction improves the agreement and it is highly suggestive that the correction of the NIMBUS/HF is indeed real and cannot be neglected. The conclusion is that most probably there is no significant secular trend of TSI during the last 20 years.

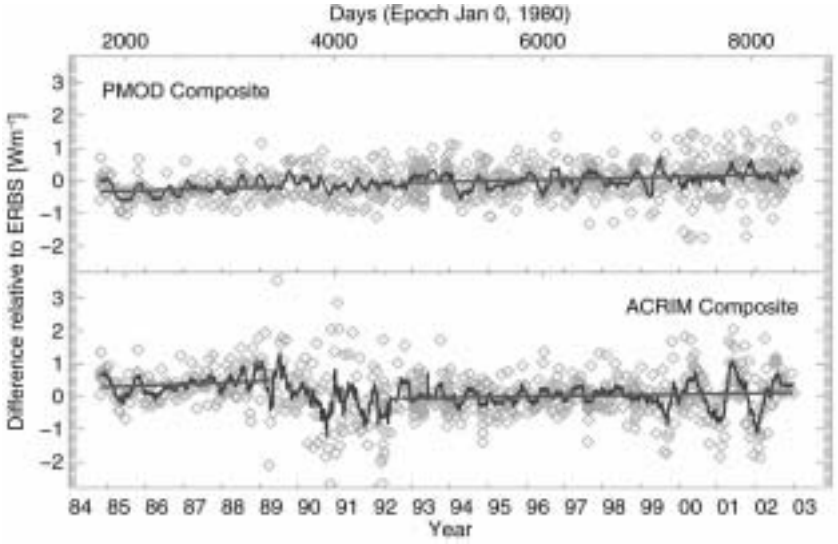

Figure 8. Comparison of the PMOD and ACRIM composite versions with ERBS data. The symbols represent the individual ERBS measurements, the red lines are the 81-day running mean filtered values and the green lines are the results of linear regressions for periods before and after the ACRIM gap.

Underestimation of Global and Diffuse Irradiance

Rolf Philipona

Reinvestigations of pyranometer calibration and field measurements endorse previous experiments showing that diffuse irradiance is underestimated due to pyranometer negative thermal offsets (Philipona, 2002). Thermal offsets measured during daytime are larger than night offsets. The experiments show negative offsets of similar magnitude on diffuse as well as on global irradiance measurements. As a consequence, the alternating sun/shade calibration method results in correct calibrations even if pyranometers are used in the traditional unconditioned way. However, the use of an unconditioned reference pyranometer results in a systematic calibration error of 1 to 2 % with the component sum calibration method. The use of component sum calibrated unconditioned pyranometers for field measurements may result in 8 to 20 Wm^{-2} underestimations of clear-sky global and diffuse solar radiation. Our experiments demonstrate the need for adequate ventilation and heating systems to suppress or at least minimize thermal offsets.

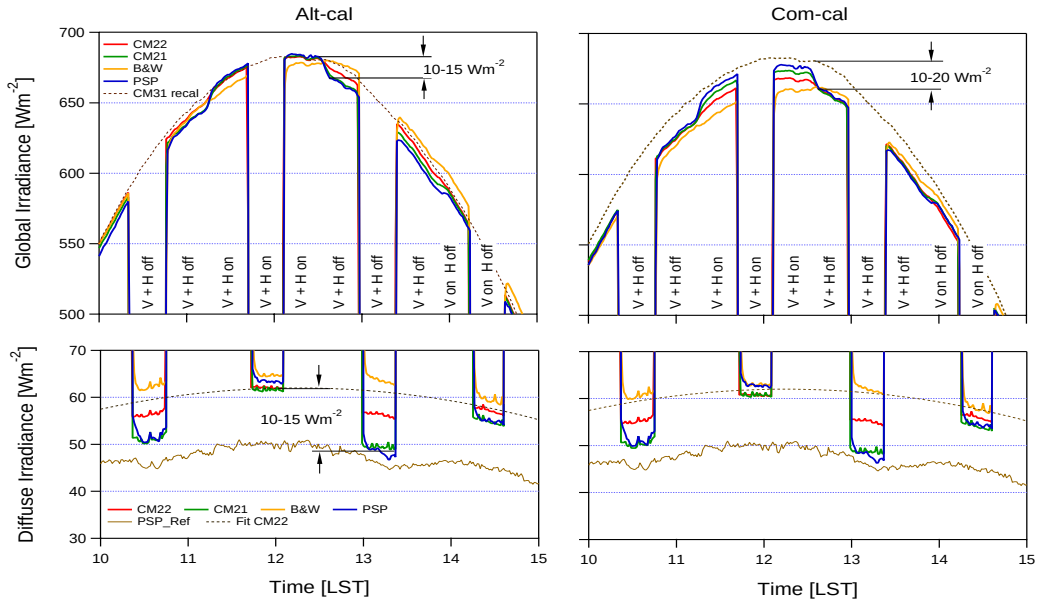

Figure 9: Global (above) and diffuse (below) irradiance sequences from Oct. 3, 2001 with alternating sun/shade (left) and component sum (right) calibration factors. Ventilation and heating on the four test pyranometers has been turned on and off. Best results for global and diffuse measurements are achieved with alternating sun/shade calibration coefficients and ventilation and heating turned on.

Improvement of Clear-Sky Index (CSI) Method

Bruno Dürr and Rolf Philipona

Observed meteorological parameters are often separated into cloud free and overcast situations for many climatological studies. The detection of cloud cover is therefore a major task in meteorology. Marty and Philipona (2000) published a simple method, called Clear-Sky Index (CSI), to detect clear skies based on downward longwave radiation (DLR), temperature and relative humidity measured at the surface. A CSI value lower or equal 1 indicates clear-sky (e.g. cloud free) conditions. However investigations showed that the original CSI has a strong clear-sky daily cycle leading to an underestimation of clear-sky moments during nighttime (see Figure 10). We correlated the deviations of the CSI during nighttime with the temperature gradient in the first 100 meter and found high correlations up to $r = -0.7$. However, the temperature gradient is not always measured, and thus, we coupled the change of the temperature gradient to the change of the temperature at the surface: a decrease of temperature at the surface leads to a decreased temperature gradient or an increased temperature inversion, and vice versa. An example of a clear-sky 24-hour day in Payerne is given in Figure 10. The original CSI shows unrealistically high values during nighttime, whereas the modified CSI indicates clear-sky conditions.

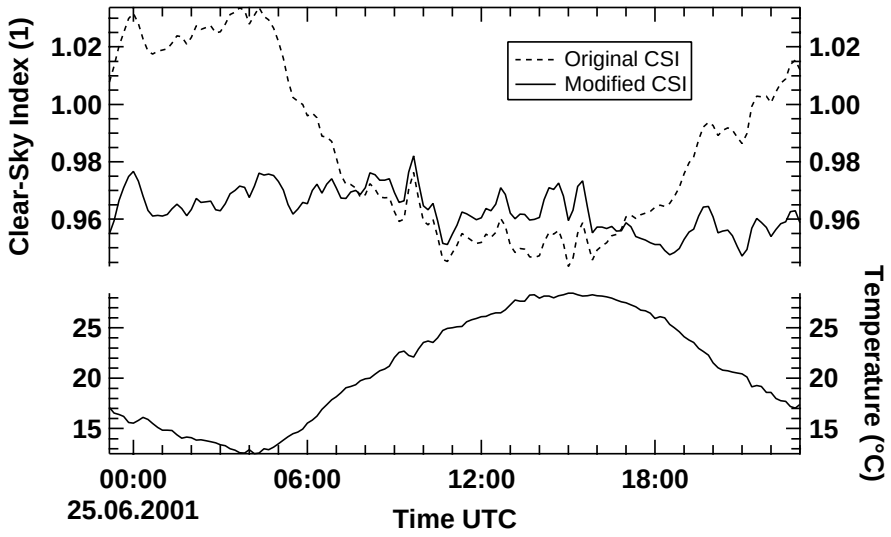

Figure 10. Comparison of original and modified Clear-Sky Index (CSI) in Payerne for a time period of perfectly clear sky on June 25, 2001. The modified CSI index is now better suited to detect clear skies also during nighttime.

Surface Radiation Measurements at North Pole

Rolf Philipona and Marcel Sutter

In spring 2002 the PMOD/WRC was offered to take part at the expedition “Mission Banquise” of Jean-Louis Etienne to measure the surface radiation budget at the North Pole. The adventurer Etienne was flown to the pole mid of April, where he sojourned with his Polar Observer, while moving south by the drift of the polar ice, until the arrival of the Russian icebreaker “Yamal“ which picked him up at about 86° north of Greenland in early July. During the three months travel our Arctic Radiation Budget Experiment “ARBEX”, which was build as a traveling standard instrument, continuously measured downward and upward longwave and shortwave fluxes as well as erythemal UV-B radiation, pressure, temperature and humidity. The measured data, which is of good quality, except for the upward shortwave component that was influenced by the close-by Polar Observer, will be used in our new SNSF project “Greenhouse effect research in the Arctic”.

Figure 11. Jean-Louis Etienne installing the ARBEX instrument in front of his Polar Observer at the North Pole (for further information see, http://www.jeanlouisetienne.fr).

Comparison of Jungfraujoch and Mauna Loa as Calibration Sites for Filter Radiometers

Christoph Wehrli

Measurements from high altitude sites are still a prime method to calibrate Sun photometers because the constraints of temporal and spatial atmospheric stability, required for successful Langley extrapolations, are rarely fulfilled below the boundary layer. But even seemingly perfect extrapolations at sites like Davos may exhibit a day-to-day scatter of several percents, much larger than the standard errors of individual calibrations. Reliable calibration values can still be determined statistically from a sequence of extrapolations; their number and the time span required to achieve a 1% uncertainty gives an indication of the 'calibration quality' for a given site. An automated, objective scheme was applied to calibrate PFR instruments at Jungfraujoch (JFJ, 3580m), Switzerland and Mauna Loa (MLO, 3397m), Hawaii.

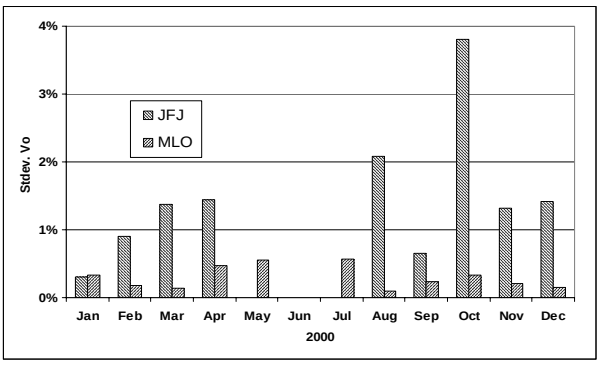

Figure 12. Statistical uncertainty of calibrations for each month in 2000. At JFJ, 1% is reached for 3 months, at MLO for every month except June, when the PFR was out of service.

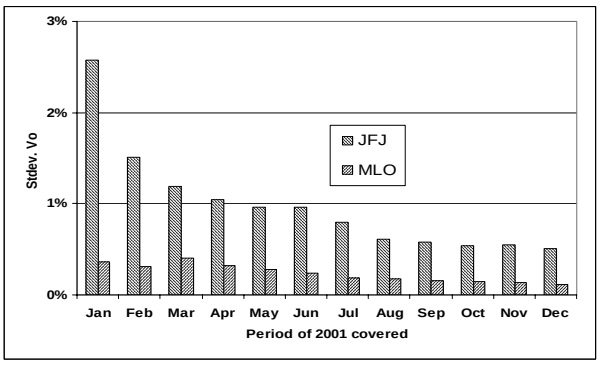

Figure 13. Calibration uncertainty versus cumulative duration of measurements in 2001. At JFJ, the 1% level is typically reached after 2 - 4 months, at MLO mostly within less than 1 month.

Results of similar quality can be obtained at both sites, as in January 2000, but midlatitude cloudiness, constrained horizon and frequent boundary layer conditions in the afternoon reduce the number of suitable days at Jungfraujoch considerably and exclude reliable calibrations during the summer months. Calibration of reference instruments for the GAW network can be obtained more efficiently at the Mauna Loa site than at Jungfraujoch.

Further details are given in a poster retrievable at ftp://ftp.pmodwrc.ch/pub/worcc/SANW-AODcalsites.pdf

International Collaborations

INTAS

Eugene Rozanov and Werner Schmutz in collaboration with the Max-Planck-Institute for Aeronomy, Katlenburg-Lindau, Germany, the Arctic and Antarctic Research Institute, St. Petersburg, Russia, and the Main Geophysical Observatory, St.-Petersburg, Russia

Funded by the International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union (INTAS) the PMOD/WRC coordinates the project “Model assessment of the solar wind effects on the general circulation of the atmosphere and global ozone distribution”. The main aim of the project is to develop the parameterization of solar wind effects on the heating rates in the lower stratosphere and to study its influence on the global chemistry and climate/weather system. The collaborating institutes are the Max-Planck-Institute for Aeronomy, Katlenburg-Lindau, Germany (two scientist), the Arctic and Antarctic Research Institute, St. Petersburg, Russia (four scientists), and the Main Geophysical Observatory, St.-Petersburg, Russia (four scientists).

In summer 2002 we organized a kick-off meeting in St. Petersburg to discuss in detail how to proceed with the project implementation. A first result of the project is a computer code to calculate the heating rate in the lower stratosphere induced by the solar wind. This code will be added to the General Circulation model with interactive chemistry, which was developed at PMOD/WRC as part of the Polyproject with the ETH Zürich. The GCM-PC code with the added heating by currents will be installed on computers of the Main Geophysical Observatory. computers, and then used to evaluate the importance of the influence of solar wind induced currents on the climate.

SCOPES

Richard Wachter, Claus Fröhlich and Werner Schmutz in collaboration with the Solar Physics department of the Ulugh Beg Astronomical Institute Tashkent, Uzbekistan

The collaboration on the project “Characteristics of Low Degree Solar Oscillations from Observations in Brightness and Velocity” started in 2001

and is funded by a SCOPES (Scientific Collaboration between Eastern Europe and Switzerland) SNSF research grant. The Uzbek institute depends strongly on foreign funding, because only very limited public means are available for science in Uzbekistan. The Tashkent institute has been involved in the ground based helioseismic networks since 1988. Currently, they are involved in the French organized network IRIS and the Taiwanese organized network TON. Our collaboration aims at analyzing SOHO/VIRGO and IRIS data. From September, 23, through October, 9, 2002, R.W. visited the Astronomical Institute in Tashkent. R.W. reports from his visit:

„Not only conditions for scientists are difficult in Uzbekistan, but also a big part of the population struggles with the hardship of everyday live. The central Asian republics were tightly integrated in the Soviet economic system and poorly prepared for becoming independent. Soviet cotton production was predominantly located in Uzbekistan, and cotton, beside gold, still is the Uzbek main export good. The real highlight of Uzbekistan is its architectural heritage, not visible in Tashkent, which was destroyed in a devastating earthquake in 1966, but well preserved (and well maintained) in Samarkand and Buchara. Tourism there shows some encouraging development, but of course is not completely independent of the political troubles in the region. Small private hotels with a really nice atmosphere were established in the last decade. As a visitor one is surprised by the very peaceful atmosphere of a country, which has a border to Afghanistan. I very much appreciated the hospitality and open-mindedness of the people in Uzbekistan“.

Solar Physics

Isabelle Rüedi in collaboration with with R. Schlichenmaier (KIS, Freiburg in Breisgau) and S.K. Solanki (MPAe Lindau)

An investigation of the spatial and temporal fluctuations of the intensity and magnetogram signal in sunspots was finished. The investigation is based on the analysis of SOHO/MDI data. The manuscript is submitted for publication.

Meeting Organization

Werner Schmutz, Sonja Degli Esposti, Tanja Egorova, Claus Fröhlich, Margit Haberreiter, Klaus Kruse, Isabelle Rüedi, and Richard Wachter

The PMOD/WRC organized the SOHO 11 symposium, which took place from 11 to 15 March 2002 at the Davos congress center. The meeting was designed to bring together the scientific users of instruments on board the SOHO satellite. The participants presented results that were based on more than 5 years of observations. The meeting title was chosen to emphasize this long mission duration – *From Solar Min to Max: Half a Solar Cycle with SOHO*. There were 167 participants and the contents of 18 invited and 21 contributed talks and 68 posters have been published in a 596-page proceedings book (ESA SP-508).

Publications

Refereed Articles

Egorova T. A., Rozanov E., Karol I., Zubov V., Malyshev S.: 2002, Modeling of the Global Total Ozone Interannual Variations in 1993 - 2000 and the Effect of Ozone-Depleted Substances Production Limitations, Meteorology and Hydrology, N1, 5 (in Russian).

Fröhlich C., Lean J.: 2002, Solar Irradiance Variability and Climate, Astron. Nachrichten 23, No. 3 / 4, 203.

Fröhlich C.: 2003, Long-Term Behaviour of Space Radiometers, Metrologia, Vol. 40, S60.

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 72, 137.

Nagurny A.P., Rozanov E.V., Egorova T. A., Medvedchenko E.Y.: 2002, Model assessment of the long-term temperature and precipitation changes in Arctic for different scenarios of possible greenhouse gas and aerosol loading, Meteorology and Hydrology, N1, 35 (in Russian).

Pap J., Fröhlich C.: 2002, International Solar Cycle Studies (ISCS), “Solar Energy Flux Study: From the Interior to the Outer Layer” – Working Group 1 Report, in Adv. Space Research, Vol. 29, No. 10, 1571.

Pap J., Fröhlich C., Kuhn J., Sofia S., Ulrich R.: 2002, A discussion of recent evidence for solar irradiance variability and climate, Adv. Space Res., Vol. 29, No. 10, 1417.

Pap J., Turmon M., Floyd L., Fröhlich, C., Wehrli C.: 2002, Total solar and spectral irradiance record, Adv Space Res., Vol. 29, No. 12, 1923.

Philipona R.: 2002, Underestimation of solar and diffuse radiation measured at Earth's surface, J. Geophys. Res., 107, 4654.

Rozanov E.V., Schlesinger M.E., Andronova N.G., Yang F., Malyshev S.L., Zubov V.A., Egorova T.A., Li B.: 2002, Climate/chemistry effects of the Pinatubo volcanic eruption simulated by the UIUC stratosphere/troposphere GCM with interactive photochemistry, J. Geophys. Res., 107 (D21), 4594.

Schmucki D., Philipona R.: 2002, Ultraviolet radiation in the Alps: the altitude effect, Optical Engineering, Vol. 41, No 12, 3091.

Skinner S. L., Zhekov S.A, Güdel M., Schmutz W.: 2002, XMM-Newton detection of hard X-Ray emission in the nitrogen-type Wolf-Rayet star WR 110, The Astrophysical Journal, 572, 477.

Skinner S. L., Zhekov S.A., Güdel M., Schmutz W.: 2002, SMM-Newton and very large array observations of the variable Wolf-Rayet star EZ Canis Majoris: Evidence for a close companion?, The Astrophysical Journal, 579, 764.

Other Publications

Dürr B., Philipona R.: 2002, Longwave Radiation Measurements Compared to Radiative Transfer and Weather Prediction Models. In: U. Baltensperger, D. Hirsch-Hoffmann (eds.), Proceedings "Workshop on Atmospheric Research at the Jungfraujoch and in the Alps" within the 182. SAS Annual Meeting, SANW, Paul Scherrer Institut, Villigen, Switzerland, p. 72.

Fröhlich C., and Wehrli C.: 2002, Variability of Spectral Solar Irradiance from VIRGO/SPM Observations, PMOD/WRC internal report.

Haberreiter M., Hubeny I., Rozanov E., Rüedi I., Schmutz W., Wenzler T.: 2002, Towards a spherical code for the evaluation of solar UV-bands that influence the chemical composition in the stratosphere. In: A. Wilson (ed.) SOHO 11 Symposium: From Solar Min to Max: Half a Solar Cycle with SOHO, ESA SP-508, ESA Publications Division, Noordwijk, The Netherlands, p. 209.

Pauluhn A., Lang J., Schühle U., Solanki S.K., Wilhelm K., Pike C. D., Thompson W. T., Rüedi I., Hollandt J., Huber M.C.E: 2002,

Intercalibration of CDS and SUMER. In: A. Wilson (ed.) SOHO 11 Symposium: From Solar Min to Max: Half a Solar Cycle with SOHO, ESA SP-508, ESA Publications Division, Noordwijk, The Netherlands, p. 223.

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Philipona R., Wehrli C.: 2002, Towards radiometric standards for longwave radiation and aerosol optical depth measurements, Third GAW-CH Conference: Ozone, Radiation and Aerosols, Swiss Agency for the Environment, Forests and Landscape UM-153-E, p. 76.

Philipona R., Wehrli C., Heimo A., Vuilleumier L.: 2002, Radiation Measurements and Climate Change in the Alps. In: U. Baltensperger, D. Hirsch-Hoffmann (eds.), Proceedings "Workshop on Atmospheric Research at the Jungfraujoch and in the Alps" within the 182. SAS Annual Meeting, SANW, Paul Scherrer Institut, Villigen, Switzerland, p. 21.

Rozanov E., Egorova T., Fröhlich C., Haberreiter M., Peter T., Schmutz W.: 2002, Estimation of the Ozone and Temperature Sensitivity to the Variation of Spectral Solar Flux. In: A. Wilson (ed.) SOHO 11 Symposium: From Solar Min to Max: Half a Solar Cycle with SOHO, ESA SP-508, ESA Publications Division, Noordwijk, The Netherlands, p. 181.

Wachter R., Schou J., Kosovichev A., Scherrer H.P.: 2002, Optimal masks for g-mode detection in MDI velocity data, In: A. Wilson (ed.) SOHO 11 Symposium: From Solar Min to Max: Half a Solar Cycle with SOHO, ESA SP-508, ESA Publications Division, Noordwijk, The Netherlands, p. 115.

Wehrli C.: 2002, Aufbau eines neuen Messnetzes für Aerosol Optische Dicke, GAW Brief #9 des DWD.

Wehrli C.: 2002, Calibration of Filter Radiometers for the GAW Aerosol Optical Depth network at Jungfraujoch and Mauna Loa, In: U. Baltensperger, D. Hirsch-Hoffmann (eds.), Proceedings "Workshop on Atmospheric Research at the Jungfraujoch and in the Alps" within the 182. SAS Annual Meeting, SANW, Paul Scherrer Institut, Villigen, Switzerland, p. 70.

Personnel

Scientific Personnel

Prof. Dr. Werner Schmutz	*Director, physicist, astrophysics, Sun-Earth connection, PI ETH-Polyproject, PI PREMOS, CoI LYRA, SOVIM*
PD 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*
Dr. Isabelle Rüedi	*Physicist, absolute radiometry, solar physics, calibration of shortwave instruments, CoI VIRGO, SOVIM, PREMOS, LYRA*
Christoph Wehrli	*Physicist, design and calibration of filter radiometers, atmosph. remote sensing, CoI VIRGO, SOVIM, PREMOS, LYRA*
Bruno Dürr	*PhD student, ETHZ, SNSF project*
Margit Haberreiter	*PhD student, ETH-Polyproject*
Tatiana Egorova	*PhD student, ETH-Polyproject (since 1.1.2002)*
Richard Wachter	*PhD student, ETHZ, SNSF project*
Chris Hoyle	*PhD student, ETH-TH-project (since 1.7.2002)*
Marcel Sutter	*PhD student, ETHZ, SNSF project (since 1.7.2002)*

Expert Advisor

Dr. Claus Fröhlich	*Physicist, solar variability, helioseismology, radiation budget, PI VIRGO, PI SOVIM, CoI GOLF, MDI*

Technical Personnel

Hansjörg Roth	*Deputy director, electronic engineer, head electronics dept., experiment manager VIRGO, SOVIM, PREMOS, LYRA*
Daniel Pfiffner	*Electronic engineer SOVIM and PREMOS*
Klaus Kruse	*Mechanic engineer, computer specialist (left 31.10.2002)*
Jules U. Wyss	*Mechanic, general mechanics, 3D design and manufacturing of mechanical parts*
Christian Thomann	*Technician*
Marcel Spescha	*Technician (since 7.1.2002)*
Ursin Solèr	*Physics Technician (since 1.9.2002)*
Marcel Knupfer	*Electronics apprentice, 1st/2nd year*
Gianmarco Külbs	*Electronics apprentice, 3rd year (left 30.6.2002)*
Christian Gubser	*Electronics apprentice, 1st year (since 16.9.2002)*

Administration

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

Caretaker

Klara Maynard	*General caretaker, cleaning*
Ida Agnello	*part time cleaning*

Civilian Service Conscripts

Lukas Imbach	*1.10.2001 – 31.1.2002*
Marco Senft	*1.9.2001 – 29.3.2002*
Jörg Kühne	*1.4. – 20.8.2002*
Christoph Stucki	*21.10. – 14.12.2002*
Bernhard Fuchs	*11.3. – 9.6.2002*
Adrian Spycher	*5.8. – 18.10.2002*
Lars Konersmann	*since 4.11.2002*

Guests, Students

Luc Curchod	*11.2. – 22.3.2002*
Aurelia Brunner	*4. – 29.3.2002*
Christiane Hatz	*1.11. – 18.12.2002*

Miscellaneous Activities

Participation in Meetings and Courses

Werner Schmutz	
25.2. – 26.2.	*Polyproject Meeting*
11.3. – 15.3.	*SOHO-11, Davos*
24.4. – 26.4.	*BWI-Seminar, Mitarbeiterführung, Zürich*
28.4. – 1.5.	*SOLICE-Meeting, Paris*
16.6. – 21.6.	*IAU Symposium #210, Uppsala*
23.6. – 26.6.	*INTAS, Visit MGO St. Petersburg*
22.7. – 26.7.	*Summer School, Alpbach*
25.9. – 28.9.	*CIMO XIII Meeting, Bratislava*
3.9. – 7.9.	*Kick off Meeting, ILWS, Washington*
18.9. – 20.9.	*SANW Jahrestagung, Davos*
13.11. – 14.11.	*LYRA-Meeting, Brussels*
9.12. – 10.12.	*Picard-Meeting, Paris*
16.12. – 17.12.	*Polyproject Meeting, KIS, Freiburg*
Sonja Degli Esposti	
4.11. – 13.12.	*Wimbledon School of English, London*
Bruno Dürr	
11.3.– 15.3.	*SOHO-11, Davos*
4.4.	*3rd Global Change Day, ProClim, Bern*
19.4.	*Symposium Prof. A. Ohmura, Zürich*
18.9. – 20.9.	*SANW Jahrestagung, Davos*
Tania Egorova	
11.3.– 15.3.	*SOHO-11, Davos*
16.9. – 25.9.	*IGAC 2002, Athen*
Claus Fröhlich	
16.1. – 18.1.	*CPS/CNES, Paris*
25.2. – 28.2..	*SORCE-Meeting, NIST, Gaithersburg*
1.3. – 4.3.	*SOHO Operations, GSFC, Greenbelt*
6.3. – 8.3.	*SOVIM-Meeting, Torino*
11.3. – 15.3.	*SOHO-11, Davos*
10.4.– 12.4..	*KIS Beiratssitzung, Freiburg i. Br.*

3.5. – 10.5.	*Starspots-Sunspots, Potsdam*
19.5. – 27.5.	*Newrad2002, NIST, Gaithersburg*
17.6. – 21.6.	*Phoebos Workshop, ESTEC, Noordwijk*
11.7.	*CPS/CNES, Paris*
14.7. – 22.7.	*SORCE-Meeting, Steamboat Springs*
25.10. – 3.11.	*SoHO-12/GONG 2002, Big Bear*
4.11. – 5.11.	*Sitzungen KIS Beirat und Stiftungsrat, Freiburg i. Br.*
11.11. – 14.11.	*Satellite Instrument Calibration Workshop, Greenbelt*
22.11.	*CPS/CNES, Paris*

Margit Haberreiter

11.3.– 15.3.	*SOHO-11, Davos*
8.4. – 13.4.	*Workshop on Stellar Atmosphere Modeling, Tübingen*
21.4. – 26.4.	*EGS General Assembly, Nice*
23.7. – 31.7.	*Summer School Alpbach, "Space Weather – Physics, Impacts and Predictions*
18.9. – 20.9.	*SANW Jahrestagung, Davos*
7.11. – 10.11.	*DPT 2002, Tübingen*
27.11. – 29.11.	*Atelier de travail Variabilité Solaire et Changement Climatique, Annecy*

Rolf Philipona

11.3. – 15.3.	*SOHO-11, Davos*
22.3.	*MCH, ETH Zürich*
4.4.	*3rd Global Change Day, ProClim, Bern*
19.4.	*Symposium Prof. A. Ohmura, Zürich*
21.4. – 24.4.	*EGS Annual Meeting, Nice*
29.4. – 24.5.	*Greenland Measurement Campaign with ETH*
27.5. – 31.5.	*BSRN-Meeting, Regina, Canada*
3.6. – 8.6.	*AMS Radiation Meeting, Ogden, Utah*
26.6.	*ACP-Meeting, PSI, Villigen*
31.7.	*GEWEX Radiationpanel, Zürich*
18.9. – 20.9.	*SANW Jahrestagung, Davos*
1.11.	*ACP Meeting, Bern*
11. – 12.12.	*Summit Workshop, ETH Zürich*

Eugene Rozanov

11.3. – 15.3.	*SOHO-11, Davos*
18.6. – 20.6..	*International Radiation Symposium for NIS countries, St. Petersburg*
23.6. – 26.6..	*Project "INTAS-2001-0432" Meeting, St. Petersburg*
1.9. – 8.9.	*VI European Symposium on Stratospheric Ozone, Göteborg*
9.10. – 17.10.	*COSPAR Conference, Houston*

Isabelle Rüedi

11.3. – 15.3.	*SOHO-11, Davos*
18.9. – 20.9.	*SANW Jahrestagung, Davos*
25.11. – 27.11.	*Solar Orbiter Payload Working Group*

Richard Wachter

11.3. – 15.3.	*SOHO-11, Davos*
4.6. – 8.6.	*200. AAS-Meeting, Albuquerque*
17.6. – 22.6.	*G-Mode Workshop, ESTEC, Noordwijk, The Netherlands*
16.9. – 30.9.	*13. IRIS-Workshop, Samarkand*

Christoph Wehrli

4.3.	*SAG-UV Meeting, Davos*
11.3. – 15.3.	*SoHO-11, Davos*
16.4.	*GAW-CH Landesausschuss, Zürich*
27.5. – 3.6.	*BSRN-Meeting, Regina, Canada*
18.9. – 20.9.	*SANW Jahrestagung, Davos*
22. – 23.10.	*GAW-CH Landesausschuss und Konferenz, Zürich*

Course of Lectures, Participation in Commissions

Werner Schmutz:

- International Radiation Commission (IAMAS)
- Comité consultatif de photométrie et radiométrie (OICM)
- Swiss Committee on Space Research (SANW)
- Commission for Astronomy (SANW)
- GAW-CH Working Group (MeteoSchweiz)
- Course of lecture „Astronomy“, WS 2002/2003 and WS 2002/2003 ETHZ
- Lecture at Summer School, Alpbach
- Examination Expert: Final Examination in Astrophysics ETHZ

Claus Fröhlich:

- Beirat Kiepenheuer Institut, Freiburg, Germany
- SOHO Science Working Team
- WMO/GAW Aerosol SAG
- Comité de Programme Scientifique de CNES

Rolf Philipona

- Working Group for Baseline Surface Radiation Network (WMO/WCRP)
- Course of lecture “Strahlungsmessung in der Klimaforschung” WS 2001/2002 and WS 2002/2003 ETHZ

Christoph Wehrli

- GAW-CH Working Group (SMA)
- WMO/GAW Aerosol SAG
- Working Group for Baseline Surface Radiation Network (WMO/WCRP)

Public Seminars at PMOD/WRC

8.7.	Photovoltaic use for buildings	Prof. Dr.-Ing. Seung-Ho Yoo, Zürich
22.7.	Modelling of cloud influence on solar radiation	Dr. Lydia Dmitrieva-Arrago, Moscow
19. – 20.9.	Annual meeting of the SGAA within the 182. annual meeting of the SANW	
19.12.	How Solar UV variability may effect atmospheric chemistry and climate	Dr. Eugene Rozanov, Davos

Guided Tours at PMOD/WRC

In 2002 we were visited by 20 groups and 4 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 Synchrotron
BiSON	Birmingham Solar Oscillation Network
BOLD	Blind to optical light detector
BSRN	Baseline Surface Radiation Network of the WCRP
BUWAL	Bundesamt für Umwelt, Wald und Landschaft, Bern
CART	Cloud and Radiation Testbed
CAS	Commission for Atmospheric Sciences, commission of WMO
CHARM	Swiss (CH) Atmospheric Radiation Monitoring, CH-contribution to GAW
CIE	Commission Internationale de l′Eclairage
CIMO	Commission for Instruments and Methods of Observation of WMO, Geneva
CIR	Compagnie Industrielle Radioélectrique, Gals
CMDL	Climate Monitoring and Diagnostic 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 - June 1993 with SOVA Experiment
EUV	Extreme Ultraviolet Radiation
FDE	Fault Detection Electronics
FWHM	Full width half maximum (e.g. filter transmission)
GAW	Global Atmosphere Watch, an observational program of WMO
GCM	General Circulation Model
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

HST	Hubble Space Telescope
IAC	Instituto de Astrofísica de Canarias, Tenerife, E
IACETH	Institute for Climate Research of the ETH-Z
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
INTAS	International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union, EU grant
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, Brussel, 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, Russia, Japan)
IUGG	International Union of Geodesy and Geophysics of ISCU
JPL	Jet Propulsion Laboratory, Pasadena, California, USA
KIS	Kiepenheuer-Institut für Sonnenphysik, Freiburg i.Br.
KrAO	Crimean Astrophysical Observatory, Ukraine
LASCO	Large Angle and Spectrometric Coronagraph
LOI	Luminosity Oscillation Imager, Instrument in VIRGO
LYRA	Lyman-alpha Radiometer, experiment on PROBA 2
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
OCAN	Observatoire de la Côte d'Azur, Nice, F
PCSR	Planck Calibrated Sky Radiometer
PFR	Precision Filter Radiometer
PHOBOS	Russian Space Mission to the Martian 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
PROBA 2	ESA technology demonstration space mission
PRODEX	Program for the Development of Experiments der ESA
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig & Berlin, D
RA	Regional Association of WMO
RASTA	Radiometer für die Automatische Station der SMA
ROB	Royal Belgian Observatory
RS422	Serial communication interface
SANW	Schweizerische Akademie der Naturwissenschaften, Bern
SARR	Space Absolute Radiometer Reference
SCOPES	Scientific Collaboration between Eastern Europe and Switzerland, grant of the SNSF

SLF	Schnee und Lawinenforschungsinstitut, Davos
SFI	Schweiz. Forschungsinstitut für Hochgebirgsklima und Medizin, Davos
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
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
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

Donations

Last year, Mr. Daniel Karbacher from Küsnacht (ZH) donated a significant amount to the PMOD/WRC. We used part of this money to purchase a sun tracker that we installed at the site used for calibrating pyranometers. The tracker is used to shade the pyranometers from direct solar radiation so that they may record the diffuse component of the radiation. Until now, only one instrument could be shaded and in addition, the old tracker was not reliable anymore. Now, 5 pyranometers can be shaded simultaneously. Figure 14 shows the instrumentation and the plate honoring the donor.

Figure 14. Sun tracker with sun shades shielding pyranometers from direct solar radiation. As the panel on the right side informs, this sun tracker was sponsored by Daniel Karbacher.

The association for the support of the foundation SFI purchased EMC test equipment for the PMOD/WRC. In order to verify how electronic components withstand against electromagnetic disturbances an EMC test is needed. Until now, PMOD/WRC engineers have carried out a crude version of this test by simply switching on and off electrical devices near the electronic components to be verified. This crude procedure does not permit a means of quantifying the strength of the EMC disturbances. Now, with the new equipment, it is possible to submit a component to a disturbance of known magnitude.

Rechnung PMOD/WRC 2002

Allgemeiner Betrieb PMOD/WRC (exkl. Drittmittel)

Ertrag	CHF
Beitrag Bund Betrieb WRC	820'000.00
Beitrag Bund Betrieb WORCC	154'280.00
Beitrag Kanton Graubünden	135'529.90
Beitrag Landschaft Davos	203'294.85
Beitrag Landschaft Davos, Mieterlass	133'500.00
Beitrag SFI, Stiftungstaxe	190'000.00
Beitrag SFI, Aufbau IR-Center	80'000.00
Beitrag MeteoSchweiz, Aufbau IR-Center	50'000.00
Instrumentenverkauf	73'019.30
Beitrag Bundesamt für Gesundheit	25'000.00
Diverse Einnahmen/Eichungen	46'702.95
Spende	25'571.20
Aktivzinsen	2'678.80
	1'939'577.00

Aufwand	CHF
Gehälter	1'094'100.40
Sozialleistungen	202'729.35
Investitionen	129'055.60
Investitionen IR-Center	80'709.75
Unterhalt	33'716.47
Verbrauchsmaterial	30'860.87
Verbrauchsmaterial IR-Center	5'764.05
Reisen und Kongresse	38'779.64
Reisen und Kongresse IR-Center	10'281.70
Administration IR-Center	33'244.50
Bibliothek und Literatur	15'239.70
Raumkosten	183'429.74
Verwaltungskosten	78'666.40
	1'936'578.17
Ergebnis 2002	2'998.83
	1'939'577.00

Bilanz PMOD/WRC (exkl. Drittmittel)

	31.12.2002	31.12.2001
Aktiven	CHF	CHF
Kassa	3'136.60	1'028.60
Postcheck	19'200.14	20'300.04
Bankkonten	504'185.96	611'293.75
Debitoren	79'094.50	109'177.90
Verrechnungssteuer	937.59	7'656.45
Kontokorrent Mitarbeiter	-146.00	-3'718.45
Kontokorrent Stiftung	44'698.40	Passiv
Kontokorrent SNF-1	298.50	68'429.95
Kontokorrent SNF-2	28'379.90	11'113.30
Kontokorrent SNF-3	9'397.30	-
Kontokorrent PREMOS	845.10	45'071.35
Kontokorrent SOVIM	272'773.08	56'296.85
Kontokorrent POLY-Projekt	1'568.00	5'405.25
Kontokorrent SCOPES	2'561.52	-
Kontokorrent SoHO-11	18'510.50	800.00
Kontokorrent INTAS	6'553.00	-
Kontokorrent TH-Projekt	570.00	-
Kontokorrent LYRA-Projekt	2'341.51	-
Transitorische Aktiven	16'739.10	2'429.10
	1'011'644.70	935'284.09
Passiven		
Kreditoren	59'826.08	56'316.55
Kontokorrent Stiftung	Aktiv	45'069.40
Transitorische Passiven	479'433.40	438'940.55
Rückstellungen	352'917.85	278'489.05
Eigenkapital	119'467.37	116'468.54
	1'011'644.70	935'284.09