pmod wrc

Annual Report 2007

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Das PMOD/WRC ist eine Abteilung der
Stiftung Schweizerisches Forschungsinstitut
für Hochgebirgsklima und Medizin in Davos

Physikalisch-Meteorologisches Observatorium Davos
World Radiation Center (PMOD/WRC)
Dorfstrasse 33
7260 Davos Dorf, Schweiz

Jahresbericht 2007

Werner Schmutz

Das Jahr 2007 war durch die Feierlichkeiten zum 100-jährigen Jubiläum des Observatoriums geprägt. Die diversen Aktivitäten bedeuteten zwar eine zusätzliche Belastung für alle Mitarbeiter, aber die Freude, positive Rückmeldungen von den verschiedensten Personen zu erhalten, entschädigte den Aufwand in jeder Beziehung. Das Resultat ist nun sicherlich, dass das „*Obs*" in der Davoser Bevölkerung viel besser bekannt und fassbarer geworden ist. Diejenigen, die einen der zwei Tage der offenen Tür besucht haben, wissen nun wirklich was wir tun. Der Preis für die vielen Aktivitäten war zwar in Franken insgesamt sehr hoch, so dass es nicht möglich ist, Öffentlichkeitsarbeit in diesem Umfang weiter zu betreiben, aber für das einmalige Jubiläumsjahr konnte Dank vieler Sponsoren das Betriebsbudget weitgehend geschont werden.

Aus internationaler Sicht war es die Konferenz *„100 Jahre UV Forschung"* die das Jubiläum in Wissenschaftskreisen bekannt machte. Es kommt ja nicht von ungefähr, dass die UV Strahlung in der ersten Hälfte des letzten Jahrhunderts mit „Dorno Strahlung", also mit dem Namen des Gründers des PMOD, bezeichnet wurde. Die Konferenz war mit rund 150 Teilnehmern sehr gut besucht. Dank guten Vorträgen, u.a. eine kompetente Zusammenfassung der Geschichte der UV Forschung am Observatorium Davos durch Claus Fröhlich, dem ehemalige Direktor des PMOD/WRC, und sicherlich auch Dank wunderbarem Davoser Herbstwetter fielen die Kommentare der Konferenzbesucher ausserordentlich positiv aus.

Das wichtigste Ereignis für den Betrieb des Institutes war, dass die neue Vereinbarung zwischen Bund, Kanton und Landschaft Davos Gemeinde zur Finanzierung des Weltstrahlungszentrums (WRC) für die Periode 2008-2011 unterzeichnet wurde. Und zwar wiederum – wie für die vergangene Periode – mit einer Erweiterung der Dienstleistungen des Weltstrahlungszentrums. Letztes Mal kam der Bereich Radiometrie der Infrarot-Strahlung dazu; dieses Mal wurde der Bereich für die Bestimmung der atmosphärischen Trübung zu einem offiziellen Teil des WRC. Damit umfasst nun das WRC drei Bereiche, die offiziell von der Meteorologischen Weltorganisation als Sektionen des WRC anerkannt werden. Die neue Vereinbarung erforderte einen Beschluss des Davoser Grossen Landrats, der ohne Gegenstimme angenommen wurde. Möglicherweise ist diese grossartige Unterstützung durch die Behörden, zumindest teilweise ein Resultat unseres verbesserten Bekanntheitsgrades in der Davoser Bevölkerung. Wie ich einleitend schon betont habe: Unser Aufwand war die Mühe wert!

Weltstrahlungszentrum Dienstleistungsbetrieb
Auch im Jubiläumsjahr lief der ordentliche Dienstleistungsbetrieb ungeschmälert weiter. Die stetig wachsende Zahl von Instrumenten-Kalibrierungen beweist, dass die Kernaufgabe des Weltstrahlungszentrums (der Unterhalt der Strahlungsreferenzen für die verschiedenen Wellenlängenbereichen) bei steigendem allgemeinem Bewusstsein für die Klimaerwärmung immer wichtiger genommen wird.

Im vergangenen Jahr konnte das Personal im Bereich zur Erforschung der atmosphärischen Trübung Dank einer entsprechend erhöhten Finanzierung durch den schweizerischen Beitrag zum *Global Atmosphere Watch* (GAW) Programm der Weltorganisation für Meteorologie von einer Person auf zwei erweiterten werden. Der Ausbau dieses Bereiches war schon lange durch eine Expertengruppe der WMO als dringend notwendig erkannt gewesen. Parallel zur personellen Erweiterung konnten wir zwei weitere Instrumente in Kapstadt und auf Borneo in Betrieb nehmen. Das weltweite Messnetz ist damit auf die von der Expertengruppe der WMO vorgesehenen zwölf Stationen ausgebaut.

Entwicklung und Bau von Experimenten
In Erfüllung eines weiteren Aspekts unseres Auftrags als Weltstrahlungszentrum stellen wir mit der Entwicklung von Messinstrumenten sicher, dass wir an der vordersten Front der Strahlungsforschung bleiben. Im letzten Jahr wurde das erste Konzept eines kryogenen Radiometers zur Messung der direkten Sonnenstrahlung bis zu den technischen Zeichnungen eines Prototypen-Instruments weiter entwickelt. Schon weiter fortgeschritten ist die Entwicklung eines neuen Absolut-Radiometers für infrarote Strahlung: Die Mitarbeiter dieser Sektion haben den Prototyp eines neuen Instruments zur absoluten Messung der Wärmestrahlung fertig zusammengebaut und in Betrieb genommen.

In den letzten Jahren waren am Observatorium drei Weltraumexperimente im Bau. Das Experiment SOVIM, an dem das Observatorium zehn Jahre gearbeitet hat, ist am 7. Februar 2008 mit der Weltraumfähre Atlantis zur Internationalen Weltraumstation gebracht worden. Das Flugmodell von LYRA wurde im März 2007 zur Integration auf dem Satelliten PROBA2 abgeliefert. Das Experiment PREMOS für den französischen Satelliten Picard ist fertig gebaut und wird nun kalibriert und getestet. Damit ist eine intensive Bauphase von Weltraumexperimenten abgeschlossen und wir erwarten mit Spannung die Daten dieser Instrumente.

Klimaforschung
Die meisten unserer Forschungsprojekte haben einen Zusammenhang mit unseren Instrumentenentwicklungen. Unter anderem planen wir mit den Daten der kommenden Weltraumexperimente LYRA und PREMOS den Einfluss der variablen Sonnenstrahlung auf das Erdklima zu erforschen. Die Klima-Gruppe bereitet diese Datenauswertung mit der nötigen Spezialisierung unseres Klimamodells SOCOL vor. Wir möchten den Einfluss der Sonnenstrahlung auf den chemischen Zustand der mittleren Atmosphäre in „Beinahe-Echtzeit" berechnen und planen in einem Testbetrieb die Resultate als Nowcasting im Internet zu veröffentlichen. Wie zeitgemäss wir mit unseren Forschungsarbeiten sind, konnten wir einem Brief des Executive Directors des United Nations Environment Programmes entnehmen, der unserm Mitarbeiter Eugene Rozanov als einer der wissenschaftlichen Mitarbeitenden am IPCC Report zum Nobel Preis gratuliert. Der Friedensnobelpreis wurde 2007 dem IPCC Team zusammen mit Al Gore verliehen.

Personelles
Cornelia Lindner, die als Projekt-Leiterin für die 100-Jahr-Feierlichkeiten bis Ende 2007 angestellt war, hat ihren Auftrag bestens erfüllt und kann mit uns auf ein sehr erfolgreiches Jubiläumsjahr zurück blicken. Wir danken ihr für ihren engagierten und wertvollen Einsatz für unser Institut.

Auf Ende Jahr endete das Anstellungsverhältnis mit Rolf Philipona, dessen Arbeitsort seit zwei Jahren in Payerne war. Er hat dort das ASRB Messnetz betreut, das von der MeteoSchweiz übernommen wurde. Ich danke ihm für die kompetente Betreuung der Übergangsphase.

Markus Suter hat im Februar seine Bachelor Arbeit erfolgreich abgeschlossen und Marcel Sutter, der ehemalige Doktorand am PMOD/WRC, einen zweimonatigen Post-doc-Einsatz, bevor er Davos in Richtung Westschweiz verlassen hat.

In der Administration hat sich die Anzahl Mitarbeiterinnen wieder um zwei Personen verringert. Annika Weber hat berufsbegleitend die Berufsmatura erfolgreich abgeschlossen und uns im Juni Richtung Unterland verlassen. Joka Sarcevic hat nach knapp einem Jahr KV-Lehre ihre Ausbildung abgebrochen um sich neu zu orientieren. Wir wünschen beiden ehemaligen Lernenden alles Gute und eine erfolgreiche Zukunft.

Zur Verstärkung der WRC-Sektion WORCC konnte zu Beginn des Jahres Dr. Stephan Nyeki engagiert werden. Als ausgewiesener Spezialist auf dem Gebiet der Aerosol-Messungen bietet er die nötige Unterstützung dieser Sektion.

Mit André Fehlmann und Stefan Wacker konnten wir die Zahl der Doktoranden am PMOD/WRC wieder auf vier erhöhen. André Fehlmann, Student der Uni Zürich arbeitet an einem SNF-Forschungsprojekt zur Entwicklung eines Kryogen-Radiometers. Stefan Wacker ist Student der Universität Bern und konnte für das Forschungsprojekt LIRAS gewonnen werden.

Neu in der Elektronik-Abteilung arbeitet Diego Wasser, der uns aus seiner Zivildienstzeit bestens bekannt war und wir freuen uns, ihn in unserem Team zu haben.

Auch in diesem Jahr haben für kürzere oder längere Zeiten Gastwissenschafter, Praktikanten und Aushilfen an unserem Institut gearbeitet: Dan Smale aus Neuseeland, Toni Viudez i Mora aus Spanien und Marco Calisto von der ETH Zürich waren als Wissenschafter zu Gast am PMOD/WRC. Fabian Weinmann hat ein Praktikum im Rahmen seiner Schulausbildung bei uns absolviert und Nico Sachs hat von Mai bis August unsere Elektronik-Abteilung unterstützt.

Last but not least: Zahlreiche Zivis hatten im vergangenen Jahr alle Hände voll zu tun um uns bei den diversen Anlässen zu unterstützen. Allen sei hiermit nochmals ganz herzlich gedankt.

Infrastruktur

Das neue Gebäude für die Strahlungs-Weltstandardgruppe war kaum eingeweiht, als die Gespräche mit dem Bundesamt für Bauten und Logistik wieder aufgenommen wurden um den weiteren Umbau das Alten Schulhauses zu besprechen. Wir benötigen dringend weitere Labor- und Büroplätze. Bevor man die Schaffung dieser Räumlichkeiten an die Hand nehmen kann, mussten Raumnutzung und Arbeitsabläufe untersucht werden um eine Gesamtplanung zu erstellen. Der Umbau wird dann auch sehr viel grösser ausfallen, soll aber die Infrastruktur für die nächsten zwei bis drei Jahrzehnte sicher stellen. Der Vorgehensplan sieht für das Jahr 2008 die Feinplanung und für das Jahr 2009 den eigentlichen Umbau vor.

Ein Filterradiometer des Typs PFR das am PMOD/WRC gebaut wurde, montiert auf einer Sonnennachführung der GAW Station Danum Valley im tropischen Regenwald von Borneo, Malaysia.

Dank

Immer wieder tragen sehr viele Personen aus Behörden und Gremien mit viel Wohlwollen dazu bei, dass unser Institut erfolgreich betrieben werden kann. Mein Dank geht an all diese Menschen, die es insbesondere im vergangenen Jahr ermöglicht haben, dass der Vierjahres-Vertrag zur Finanzierung des Weltstrahlungszentrums erneuert werden konnte. Der wichtigste Beitrag zum Erfolg kommt aber immer vom Personal. Ich danke allen Mitarbeiter ganz herzlich für ihren stets motivierten Einsatz. Das letzte Jahr war für viele speziell, weil wir zusätzlich all die Anlässe des 100-Jahr Jubiläums organisieren mussten. Möglich wurden sie Dank den grosszügigen finanziellen Beiträgen der Sponsoren – durchgeführt wurden sie aber von den Mitarbeitern. Ein herzliches Dankeschön an alle Beteiligten, dass das Jahr 2007 so gut gelungen ist!

Davos, März 2008
Werner Schmutz, Prof. Dr. sc. nat.
Direktor PMOD/WRC

Eine von 200 Fahnen die von den Davoser Schulkinder für die 100-Jahre Feier des PMOD gemalt wurden. Die Fahnen wehten im Sommer und Herbst 2007 entlang der Auffahrt zum Alten Schulhaus.

100 Jahre PMOD – Aktivitäten im Überblick

Stephanie Ebert

Im Jahr 2007 feierte das Physikalisch-Meteorologische Observatorium Davos sein 100-jähriges Bestehen. Gegründet wurde das Observatorium 1907 durch den aus dem deutschen Königsberg stammenden Carl Dorno. Dieser wollte – mit dem Hintergrund seiner an Tuberkulose erkrankten Tochter – Fragen klären wie: „Wie verhalten sich die Helligkeiten in Höhe und Ebene“ und „was sind klimatisch relevante Eigenschaften des Kurortes Davos?“. Heute sind wir ein international renommiertes Forschungszentrum. Unser Tätigkeitsgebiet setzt sich aus mehreren Teilbereichen zusammen, wobei in allen Bereichen die Messung der Sonnenstrahlung im Zentrum der Arbeit steht.

Das Jubiläumsjahr haben wir genutzt, um durch verschiedene Veranstaltungen den Bekanntheitsgrad des Instituts in der Öffentlichkeit und vor allem in der Davoser Bevölkerung zu erhöhen.

Einweihung Linienbus VBD

05. Januar 2007 Einweihung Linienbus VBD

Der Auftakt zum Jubiläumsjahr! Ein ganz besonderer Werbeträger kam durch die grosszügige Sponsorenzusage der Elektrizitätswerke Davos zustande: Ein ganzes Jahr lang konnte die Davoser Bevölkerung mit „unserem“ Bus durch Davos fahren.

05. Januar 2007 Eröffnung Sonderausstellung Heimatmuseum Davos

Die Sonderausstellung „100 Jahre Physikalisch-Meteorologisches Observatorium Davos“ im Heimatmuseum wurde gleich zu Beginn des Jahres mit einer Vernissage eröffnet. Dieser erste öffentliche Auftritt war ein voller Erfolg die Räumlichkeiten des Heimatmuseums voll. Von Januar bis April und von Juli bis Oktober zeigte die Ausstellung 20 Instrumente des PMOD. Christoph Wehrli hat die Instrumente, die die Entwicklung der Strahlungsmessung sowie die Geschichte der Weltraumexperimente präsentierten, zusammengestellt.

Ab Januar 2007 Fensterbeleuchtung

Von Januar bis März 2007, während der Juni-Jubiläumswoche und zuletzt im Winter 2007 leuchteten die Fenster der Südfassade unseres Gebäudes im Dunkeln mit folgendem Schriftzug: 1907 2007 PMOD.

Fensterbeleuchtung

12.-14. März 2007 *“10th International Symposium on Physical Measurement and Signatures in Remonte Sensing“*

Mit Zustimmung der Organisatoren der Universitäten Wageningen (NL) und Zürich wurde das „10th International Symposium on Physical Measurement and Signatures in Remote Sensing“ in die Reihe der 100-Jahr-Aktivitäten eingegliedert. Wir übernahmen dabei einen Teil der lokalen Organisation, boten Führungen durch das Observatorium an und stellten die Tätigkeiten des Weltstrahlungszentrums in einem Vortrag vor. So konnten zahlreiche Tagungsteilnehmer das PMOD/WRC besser kennen lernen.

21. März 2007
23. Juni 2007 Tage der offenen Tür

Am 21. März sowie am 23. Juni 2007 öffneten wir unsere Tore für Interessierte, die Spannendes über Strahlungsmessung, Klimarechnung, Aerosole und Sonnenphysik, über ultraviolettes und infrarotes Licht und über die Herstellung von Experimenten für Weltraumprojekte erfahren oder einfach das Institut näher kennen lernen wollten. Aufgrund diverser Werbemassnahmen für diese Anlässe haben wir eine Vielzahl begeisterter Besucher anlocken können. Viele der Besucher waren natürlich auch ehemalige Schüler, die ihr altes Schulhaus einmal wiedersehen wollten.

Tage der offenen Tür

07. Juni 2007 Ausstellung EWD, Infoveranstaltung "Sonnentage"

Im Rahmen einer Ausstellung der Elektrizitätswerke Davos über Sonnenenergie fand am 07. Juni in Zusammenarbeit mit dem PMOD eine Infoveranstaltung „Sonnentage“ statt. Wir stellten Informationstafeln über die Sonne und deren Strahlung zur Verfügung und bauten ein Experiment, das die Strahlungswerte auf dem Dach der EWD mass und im Ausstellungsraum anzeigte.

Ausstellung EWD, Infoveranstaltung "Sonnentage"

10. Juni 2007 *"Day of International Heliophysical Year (IHY)"*, öffentliche Fachvorträge zum Thema Sonnenphysik

Der 10. Juni 2007 wurde von der UNO zum „Day of International Heliophysical Year (IHY)“ ernannt. Aus diesem Grund präsentierte das PMOD/WRC für Interessierte drei Fachvorträge zum Thema Sonnenphysik: Im ersten Vortrag erklärte Margit Haberreiter die „Phänomene der Sonne“, im zweiten Vortrag Wolfgang Finsterle „Die schwingende Sonne“ und im dritten Vortrag Werner Schmutz „Der Einfluss der Sonne auf das Klima“. Dieser Tag hatte zum Ziel, das Verständnis über die sonnenphysikalischen Vorgänge bewusst zu machen bzw. darüber zu informieren, das Interesse für heliosphärische Prozesse zu wecken sowie die Verbindung von Sonne, Erde und Heliosphäre und die Relevanz zwischen Weltraum- und Erdwissenschaften aufzuzeigen.

18.-21. Juni 2007 „Sonnenforschung für Schulen“ Besuch von insgesamt 550 Schülerinnen und Schülern

Ursprünglich war geplant, den interessierten Davoser Schülerinnen und Schülern an einem Tag die Möglichkeit zu geben, sich mit dem Thema Wissenschaft, insbesondere mit der Sonne und dem Einfluss der Sonnenstrahlung, auseinanderzusetzen. Das Interesse war allerdings so gross, dass wir das Angebot auf ganze vier Tage ausdehnen mussten. In dieser Zeit besuchten uns 26 Klassen mit 550 Schülerinnen und Schülern.

Sonnenforschung für Schulen

Die von Davoser Kindern gemalten Fahnen entlang der Auffahrt zum Alten Schulhaus

Darüber hinaus hatten jüngere Schulkinder und Kindergartenkinder die Aufgabe, Fahnen zum Thema „Sonne“ zu malen. So hatten wir letztendlich 200 Fahnen, die an 20 Masten von Juni bis November die Auffahrt zum Institut schmückten. Diese Fahnen wurden allesamt auf einem Foto festgehalten und als Andenken auf einem Poster zusammengestellt (http://www.pmodwrc.ch/pics/100jahrfeier/Fahnen_A4.jpg).

22. Juni 2007 Jubiläumsfeier (VIP-Veranstaltung)

An der offiziellen Jubiläumsfeier wurde das mit Bundesgeldern finanzierte und neu erstellte Glasgebäude für die Weltstandardgruppe eingeweiht. Eingeladen waren rund 50 Persönlichkeiten aus Wissenschaft, Politik und Wirtschaft. Unter anderem nahmen teil: Dr. Martin Schmid, Regierungspräsident Kanton GR, Pascal Strupler, Generalsekretär EDI, Prof. Petteri Taalas, Director of Development Co-operation and Regional Activities at WMO. Der Festvortrag am Observatorium wurde von Prof. Claude Nicollier gehalten.

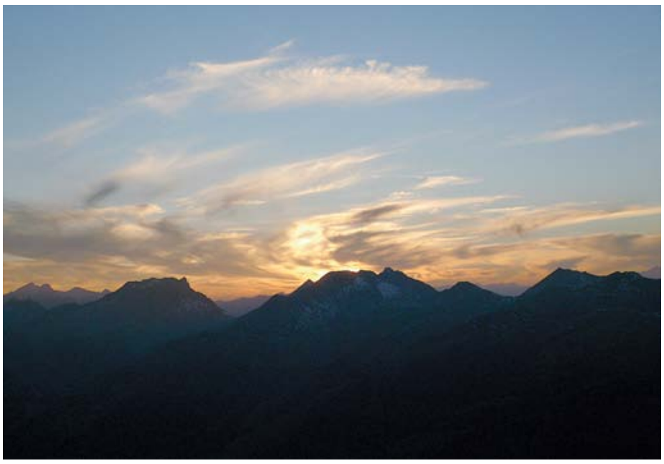
Öffentlicher Vortrag Claude Nicollier im Kongresszentrum

22. Juni 2007 Öffentlicher Vortrag Claude Nicollier

Eines der Highlights in unserem Jubiläumsjahr war sicherlich der öffentliche Vortrag von Claude Nicollier im Kongresszentrum Davos. Der Schweizer Astronaut setzte 1992 bei einem seiner Weltraumeinsätze das PMOD/WRC-Experiment SOVA auf der Instrumentenplattform EURECA ins Weltall aus. Mit ihm und seinem Vortrag „Schritte im Weltraum“ konnte das Publikum in die Ferne schweben. Der Zuschauerandrang war sehr gross, der Saal mit 300 Personen an der Grenze seiner Kapazität.

15. Juli 2007 Jazz-Konzert

Wie auch in den letzten Jahren fand natürlich auch in unserem Jubiläumsjahr ein Jazz-Konzert als Teil der Davoser Jazz-Woche „Davos Sounds Good“ bei strahlendem Wetter auf dem Vorplatz des Instituts statt.



Stimmungsbild vom Abend der Sun- and Starparty auf dem Jakobshorn

15. September. 2007 Sun- and Starparty

In Zusammenarbeit mit dem Verein Hobby-Astronomen Graubünden, der 2007 sein 25-jähriges Bestehen feierte, organisierten wir einen gemeinsamen Event: Eine Sun- und Starparty. Am Nachmittag wurde auf dem Vorplatz des Instituts die Sonne beobachtet, am späten Abend auf dem Jakobshorn der Sternenhimmel. Neben zahlreichen Amateur-Astronomen nahmen auch sehr viele Einheimische teil, die einiges über Astronomie lernen konnten. Insgesamt waren es 130 Personen, die mit Teleskopen und anderem Material in vier Seilbahnfahrten auf den Gipfel des Jakobshorns transportiert wurden und erst nach Mitternacht ihre Entdeckungsreise beendeten.

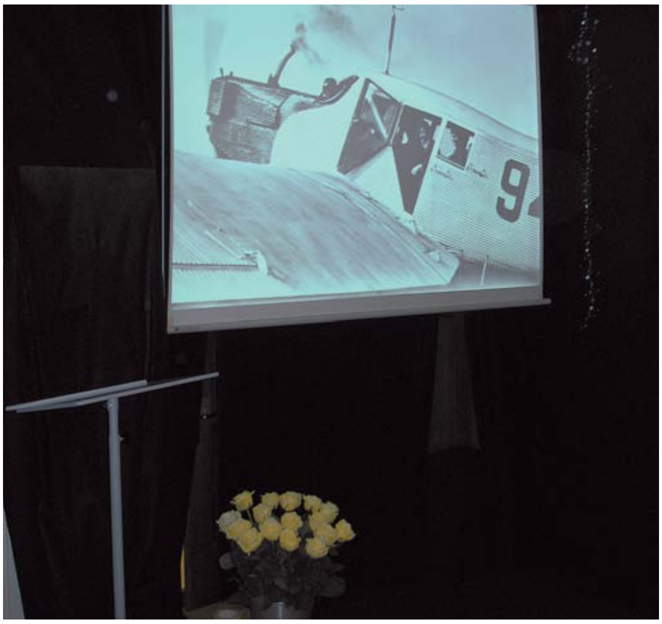
18.-20. September 2007 UV-Conference "One Century of UV Radiation Research", Kongresszentrum Davos

Die rund 100 Teilnehmer aus der ganzen Welt sowie sieben eingeladene Experten diskutierten während drei Tagen über die derzeitigen Fragestellungen im Bereich der solaren UV Strahlung. In seinem Festvortrag gab der ehemalige Direktor des PMOD/WRC, Claus Fröhlich, einen spannenden Rückblick auf 100 Jahre UV Forschung. Aktuelles Thema war der Einfluss der solaren UV Strahlung auf den Menschen, insbesondere deren positiver Einfluss auf die Produktion von Vitamin D3 durch dosierte Exposition der Haut. Hauptaufmerksamkeit wurde jedoch der Messung und Modellierung solarer UV Strahlung gewidmet, wobei neue Messmethoden sowie neue Messinstrumente vorgestellt wurden. Im Rahmen des abschliessenden Dinners wurde J. Lenoble für ihr Lebenswerk geehrt.

Teilnehmer UV-Conference

22. Dezember 2007 Lesung Charles Linsmayer „Liebe und Tod am Himmel Europas", Abschlussveranstaltung Jubiläumsjahr

Zusammen mit der Kunstgesellschaft Davos wurde das Jubiläumsjahr mit einer Lesung von Charles Linsmayer feierlich beendet. Charles Linsmayer erzählte mit „Liebe und Tod am Himmel Europas" über das Leben des Flugpioniers Walter Ackermann und wurde dabei von einem Saxofon-Ensemble der Kammerphilharmonie Graubünden musikalisch begleitet. Auch zu diesem Anlass fand sich eine grosse Schar Gäste im weihnachtlich erstrahlenden Institut ein um mit uns gemeinsam dieses aussergewöhnliche Jahr ausklingen zu lassen.



Lesung Charles Linsmayer

Ende 2006 – Ende 2007 Analemma

Ein weiteres Projekt wurde durch Wolfgang Finsterle Ende 2006 gestartet. Er verfolgte das sogenannte Analemma-Projekt mit einer analogen Fotokamera und machte ein Jahr lang um 10:00 Uhr (Winter) bzw. um 11:00 Uhr (Sommer) jeden 10. Tag ein Foto der Sonne. Das entstandene Sonnen-Analemma ist eine Visualisierung der Abweichung der Sonnenzeit zu unserer Urzeit. Die Mittelschülerin Miriam Meier von der SAMD hat parallel dazu im Rahmen ihrer Maturaarbeit das Sonnen-Analemma mit einer Digitalkamera fotografiert und die Schattenpunkte einer Stange im Pausenhof der SAMD aufgemalt. Die Resultate dieses Experiments wurden auf www.pmodwrc.ch veröffentlicht.

Sonnen-Analemma über dem Büelenberg

Introduction

Werner Schmutz

Last year was notable for the numerous events related to the 100th anniversary of the PMOD. While the additional work was a burden on our relatively small staff, it was worth the effort, and the strong positive reaction from the public was both rewarding and extremely gratifying. As a result of these events, the observatory in Davos is better known in the regional community. And those who visited the observatory during the two open-house events held last year also have a much clearer idea of what we do. The price tag for these events was quite high, and unfortunately, for financial reasons, we are not able to continue our public outreach activities at such an intense level. We were fortunate to find several sponsors who provided funds that covered, to a large extent, the additional expenses and we are grateful to these sponsors, as their generosity prevented the observatory budget from being too severely strained.

In addition to our local outreach efforts, the PMOD increased its awareness among the international community by hosting a scientific conference last year (September 18-20) celebrating a century of UV Radiation Research. The founder of the PMOD, Carl Dorno, was known primarily for his research in UV radiation and as a result UV radiation was known as Dorno radiation among German-speaking scientists during the first half of the last century. Nearly 150 participants – an exceptionally good turnout – attended the September conference on the topic of meteorological UV radiation. Thanks to the high quality of the talks, the comprehensive summary of the history of UV research at the PMOD by former director Claus Fröhlich, and the wonderful fall weather, the conference was a huge success and we received positive feedback from the participants regarding their visit to Davos and the observatory.

The most important event regarding the operational service of the World radiation Center (WRC) was the successful renewal of the contract for the years 2008 to 2011. The contract is an agreement between the Swiss Government, the Kanton Graubünden, and the county of Davos to pay for the operation of the WRC. As was the case in the previous contract for 2004-2007, the WRC was enlarged by an additional section. The WRC has now three sections with the newest being the section for Atmospheric Turbidity. The enlargement of the WRC also required a larger contribution from all partners including the county of Davos. The Grosser Landrat, the legislature in Davos, was required to vote in November 2007 on increasing the annual funds provided from the county's budget to the PMOD/WRC. I am happy to report that the measure passed unanimously. This overwhelmingly favorable outcome is possibly due, in part, to the heightened public awareness of the observatory resulting from our outreach efforts of the past year. As I said earlier, it was worth all the work!

Figure 1. *Group photo taken on June 22, 2007 during the celebration of the 100th anniversary of the PMOD and the inauguration of the new annex for housing of the World Standard Group of pyrheliometers. The ceremony was attended by Prof. Petteri Taalas, director of Development Co-operation and Regional Activities at WMO, Pascal Strupler, Generalsekretär EDI, Dr. Martin Schmid, Regierungspräsident Kt. GR, and several other federal and local politicians involved in the financing of the PMOD/WRC.*

Operational Services

Statistics of Calibration, Commercial Activities, and Quality Management System

Silvio Koller

UV Calibrations

The Ultraviolet Calibration Center of the PMOD/WRC calibrated three spectroradiometers at their respective field sites using the traveling reference spectroradiometer QASUME. One UVA broadband radiometer was calibrated and the QASUME irradiance scale was transferred to three standard lamps from two European institutes. In September 2007, 16 Brewer spectrophotometers and 23 broadband erythemal radiometers were calibrated relative to the QASUME spectroradiometer during the 2nd RBCC-E campaign at El Arenosillo, Spain.

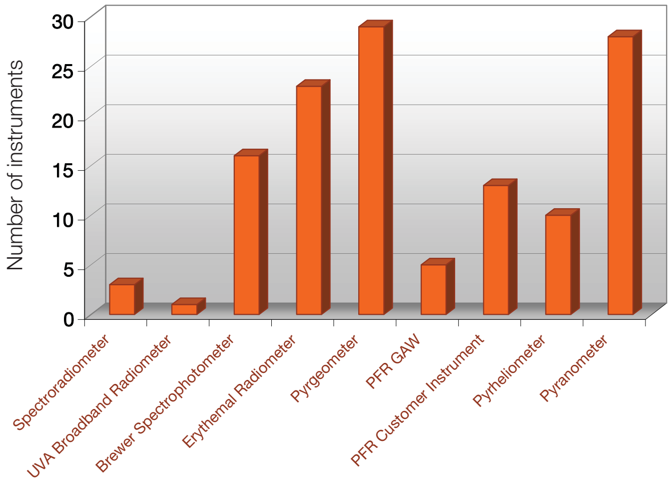


Figure 1. *Statistics of instrument calibrations at PMOD/WRC.*

Infrared Calibrations

The infrared radiometry section of the World Radiation Center calibrated 29 Pyrgeometers in 2007. Each instrument was first characterized with a black-body source; the final calibration was obtained by direct outdoor comparison of downwelling longwave irradiance against the World Infrared Standard Group (WISG) of pyrgeometers.

Precision Filter Radiometer Calibrations

Thirteen PFR were calibrated in 2007. Five instruments are part of the Global Atmosphere Watch (GAW) network, and eight instruments belong to national institutes.

Pyrheliometer/Pyranometer Calibrations

(acc. to ISO/IEC 17025)
The WRC section "Solar Radiometry" calibrated 38 instruments during 74 days of measurements. The instrument types were: 7 Actinometers, 3 Active Cavity Radiometers and 28 Pyranometers.

Instrument Sales

Five Precision Filter Radiometers were sold in Asia and Europe, which corresponds to the average number of PFR sales over the last three years. We have also sold two PMO6-cc pyrheliometers and nine ventilation systems. In total the income from instrument sales was over 50 % higher than financially planned.

PMOD Quality Management System for Calibration Tasks

PMOD/WRC calibrates pyrheliometers and pyranometers according to the international standard ISO/IEC 17025. The two claimed Calibration and Measurement Capabilities (CMC) – Responsivity, direct and global solar irradiation – are still within the review and approval process.

PMOD/WRC attended one inter-laboratory comparison at NREL in September 2007 and carried out one external audit, conducted by a METAS/SAS technical auditor.

Solar Radiometry Section (WRC-SRS)

Wolfgang Finsterle

The Solar Radiometry Section (SRS) of the WRC maintains and operates the World Standard Group (WSG) of pyrheliometers, which form the primary reference for direct solar irradiance measurements worldwide, the World Radiometric Reference (WRR).

Performance of the WSG

The individual instruments of the WSG are regularly compared to the average of the group in order to monitor their long-term stability. Currently five of the six WSG instruments are considered trustworthy while one instrument (HF18748) suffered from two unexplained sudden drops in signal in late 2006. The accumulated amplitude of both drops is of order -0.1 %. The following investigation did not reveal the cause for the drops. The instrument continued to operate throughout 2007 but never recovered. While this incident did not affect the stability of the WRR it still illustrates the vulnerability of the WSG as an artifact based standard. On the upside it proves that the monitoring procedures as foreseen by the WRC/SRS quality management are appropriate and capable of detecting the failure of an individual WSG instrument.

Figure 1: *The WRC/SRS travelling standard with PMO5 (top), PMO6-0401 (middle) and AHF-32455 (bottom) during the WMO Regional Pyrheliometer Comparison of RA-II (Asia) on Mount Tsukuba, Japan. In the distance the snow-covered slopes of Mount Fuji are just visible.*

Figure 2: The observing site during the U.S. National Pyrheliometer Comparison at Golden, Colorado.

Considering the plus 30 year age of most WSG instruments it seems unavoidable that such glitches will occur more often in the future. The WRC/SRS follows a dual strategy to cope with this challenge. While new instruments currently undergo long-term stability tests to become future members of the WSG a novel approach is the development of a cryogenic standard for solar irradiance. A project was accordingly kicked-off in spring 2007 in collaboration with METAS in Wabern and NPL in London (see instrument development section in this report).

Enhanced solar tracker

In March 2007 a new hydraulics system and control electronics were installed on the solar tracking platform. The old system was in operation for over 30 years but was becoming less reliable in recent years. The new control electronics was designed and built by the PMOD electronics department. It uses angular encoders on the azimuth and elevation axes for coarse guiding as well as a four-quadrant solar sensor for high-accuracy pointing. The coarse guiding capability allows the solar sensor to automatically reacquire the Sun at start up as well as when occasional clouds pass in front of the solar disk. The accuracy and reliability were thoroughly tested during the exceptionally sunny April 2007 weather. The ease of use of the new tracking system was much appreciated by our WSG operator during the summer calibration season.

Regional and National Pyrheliometer Comparisons

The WSG was represented by one WSG instrument (PMO5) at the WMO Regional Pyrheliometer Comparison of RA-II (Asia) held on Mount Tsukuba, Japan, January 22-31. The preliminary outcome of the comparisons confirmed the results of IPC-X (2005). New WRR factors were assigned to national standard pyrheliometers from Korea and Hong Kong.

Between September 25th and October 1st a travelling standard consisting of two instruments (PMO6-0401 and AHF-32455) participated in the U.S. National Pyrheliometer comparison at Golden, Colorado, where the agreement of the U.S. national standard group with the WRR was confirmed.

Infrared Radiometry Section (WRC-IRS)

Julian Gröbner

The IRS operated continuously for the whole of 2007, providing a stable atmospheric longwave irradiance reference realised through the World Infrared Standard Group (WISG) of pyrgeometers. The long-term stability of the WISG is better than ±1 Wm^{-2} since the start in September 2003, even though it now seems that one of the four instruments is showing a slight drift in sensitivity. A fifth candidate instrument which was put into continuous operation in the summer of 2006 has been completely stable and would be a possible candidate for inclusion in the WISG instead of the questionable instrument.

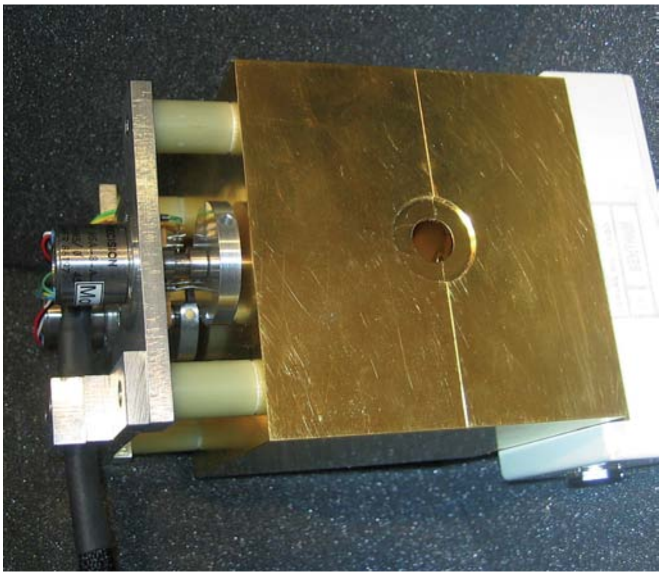


Figure 1: The infrared radiometer IS1 consists of a gold plated integrating sphere and a pyroelectric detector. The radiation is modulated by two shutters placed inside the integrating sphere (not visible).

The design and construction of an infrared radiometer for measuring atmospheric longwave radiation was initiated in 2007. The prototype instrument is shown in Figure 1 and essentially consists of a gold plated integrating sphere with three openings and a pyroelectric detector. The radiation is modulated by two shutters mounted inside the integrating sphere in front of two holes, while the detector is mounted at the third. The pyroelectric detector alternatively sees the radiation from each of the two sphere openings. While the primary opening is used to sample the atmospheric radiation, the second opening is used to sample the reference radiation, emitted by a cryogenic cavity cooled to 77 K. A diamond window serves as interface between the cryogenic cavity and the integrating sphere. The prototype was assembled by the end of 2007, and the laboratory characterisation started in January 2008. Atmospheric measurements are planned during 2008.

A new reference blackbody cavity was commissioned in 2007. It consists of a tilted bottom cavity with specifically chosen dimensions to obtain a high effective emissivity at its aperture. Testing of pyrgeometers in the original and new cavity demonstrated the high consistency between the two systems. Differences between the cavities are less than ±0.5 Wm^{-2}, and pyrgeometer tests performed in each cavity give results which are within their stated uncertainties. The validation phase was officially closed in December 2007, and as of January 2008 the new blackbody cavity will be used as the operational system.

A monochromatic light source facility (MIRSF) was delivered to PMOD/WRC in September 2007. It allows the determination of the spectral transmission of filters and pyrgeometer domes over the wavelength range 1 µm to 40 µm. The system was used to measure the spectral transmission of several filters which will be used in the new infrared radiometer which is being constructed. Also, several pyrgeometer domes were measured with the facility to calibrate these pyrgeometers in the laboratory using a novel calibration method published in September 2007. The methodology was validated using two custom-made CG4 pyrgeometers. If the approach is shown to also give consistent results for additional pyrgeometers, it would allow the calibration of pyrgeometers directly in a blackbody cavity.

In 2007, the Atmospheric Radiation Monitoring Program of the U.S.A., and the Bureau of Meteorology, Australia, sent several of their reference pyrgeometers to PMOD/WRC to create a regional pyrgeometer reference group for their respective networks. Thus, pyrgeometer measurements under the responsibility of these two institutes will become traceable to the World Infrared Standard Group operated at Davos.

Atmospheric Turbidity Section (WRC-WORCC)

Christoph Wehrli and Stephan Nyeki

The available manpower has effectively been doubled since February 2007 when Dr. Stephan Nyeki joined WORCC. He brings his wide experience in the field of aerosol measurements (AOD; physical and chemical properties) gained at the Paul Scherrer Institute, MeteoSwiss and the University of Bern. Besides scientific analysis of AOD data, he will also contribute toward the goal of near real time processing of measurements in the GAWPFR network.

Operations of the GAWPFR network continued smoothly at most of the 9 stations which have submitted data in the past. Measurements at the Jungfraujoch were hindered in the first 10 months of 2007 as the MeteoSwiss automated dome was still inoperative due to major restructuring of the SwissMetNet infrastructure since August 2006. However, the dome has now been in operation since November 2007. First PFR results indicate that the instrument needs to be recalibrated. The analogue data link was replaced by a direct internet connection. Jungfraujoch serves as a test site for upgrading further stations towards near real time access in the global GAWPFR network.

Data delivery from Mace Head has been temporarily interrupted since April 2007 due to a change of local staff. Meanwhile the measurements have been retrieved but additional quality control is needed for evaluation.

In May, a PFR instrument was delivered and installed at the Danum Valley GAW station in Malaysia. Two other PFRs were delivered to Cape Point, South Africa, and Mount Waliguan, China. By the end of 2007, both systems were in operation in test mode at the respective main offices of the national weather services. Final deployment to the GAW observatories is scheduled for early 2008. With the addition of these three new stations, the GAWPFR network has attained its full, planned extent of 12 stations.

Another PFR was delivered and installed in October 2007 at the Met Éireann, Valentia observatory in Caherciveen, Ireland. This instrument is one of more than 40 PFRs purchased by national meteorological services over the last few years. Met Éireann has agreed to submit measurements to WORCC, thereby increasing the number of GAWPFR stations to 13.

Measurements of all GAW stations active in 2007 were processed at WORCC, but have not yet been submitted to WDCA.

Our CIMEL radiometer was recalibrated in order to promote its measurements in 2006 to quality assured level 2 status in AERONET. Technical problems necessitated repair by the manufacturer on two separate occasions. As a consequence, the instrument was off-line for a total of 26 weeks in 2007. The MFRSR radiometer was delivered in January and took up routine measurements at Davos in May after a lengthy series of tests. Data reduction to AOD and comparison with our PFR measurements is still pending.

In the frame of the European Supersites for Atmospheric Aerosol Research (EUSAAR) project, PMOD/WORCC is participating as a sub-contractor to the Paul Scherrer Institute, Switzerland, and is responsible for AOD quality assurance within an international network of EUSAAR sites. An initial instrument intercomparison campaign was held at Davos from 24th September to 27th October, comprising 6 instruments which represented 2 EUSAAR sites and 2 AOD calibration centres. More than 60 hours of cloud-free observations under very clear atmospheric conditions were collected. Preliminary results of the intercomparison demonstrate good agreement of measured AOD values at 500nm and 865nm with average differences between instruments on the order of <0.01 and a

Figure 1: *At Cape Point on the southern tip of Africa, a PFR has started observations of AOD.*

scatter for individual measurements of about 0.015 optical depths. A more detailed evaluation of the comparisons is still under way. AOD observations at additional EUSAAR sites will be verified using a travelling standard PFR instrument over the project period that ends in January 2011. For this purpose, a compact solar tracker (STR-22 model, EKO Instr.) and a dedicated PFR were purchased.

WORCC is at present developing a central facility with a web-based user interface for unified processing, archiving and presentation of PFR measurements within GAWPFR. The homepage (www.pmodwrc.ch/worcc) is now fully online, and amongst information on PFRs etc, preliminary AOD time-series at available stations are presented. As before, WORCC makes this data available in graphical format, while ASCII data may be downloaded from the WDCA website (wdca.jrc.it). Work is at present underway to automate data collection and processing. This has so far been achieved with data from 3 GAWPFR stations (Jungfraujoch, Davos, and Valentia), with 2 more (Bratts Lake and Mauna Loa) to follow shortly.

European Ultraviolet Calibration Center (EUVC)

Julian Gröbner and Gregor Hülsen

In its second year of operation, the EUVC consolidated its position as European reference center for solar ultraviolet radiation measurements by taking part in a number of international calibration campaigns held in Finland, Italy and Spain. Several institutes have also started using the EUVC irradiance reference at their home sites which represents the necessary initial step towards a homogeneous UV radiation reference in Europe.

The two reference spectroradiometers of the EUVC, Brewer #163 and QASUME, joined the 2nd RBCC-E campaign held in September at El Arenosillo, Spain. While Brewer #163 was calibrated against the RBCC-E total column ozone reference, QASUME acted as the UV reference for the 16 participating Brewer spectrophotometers and for the 23 UV broadband radiometers which participated at a national broadband calibration campaign organised at the same location.

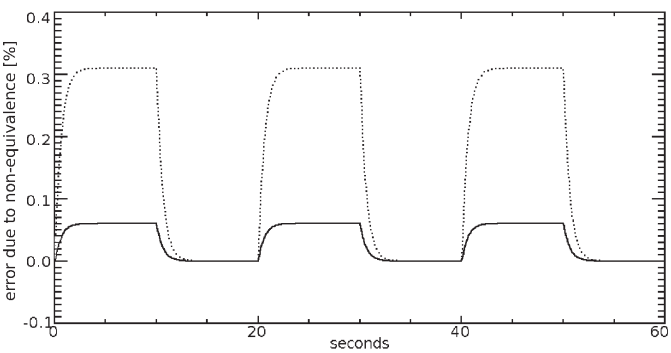
A key activity in 2007 was the analysis of results from the COST 726 measurement campaign held in 2006 and the production of the final report of this activity, which can be found at the COST 726 web-site (http://www.cost726.org). This campaign also allowed the calibration performance from seven international UV calibration laboratories to be compared, a task which has been promoted by the CIMO Expert Team on Meteorological Radiation and Atmospheric Composition Measurements as well as by the GAW SAG UV.

In November 2007, the close collaboration with the Institute for Health and Consumer Protection of the Joint Research Centre in Ispra, Italy was instrumental in extending the use of the former ECUV infrastructure into an indefinite loan for PMOD/WRC. As of January 2008 and following a formal request by the WMO, the EUVC has become the UV Regional Calibration Centre for Europe as part of the WMO Global Atmosphere Watch Programme.

Instrument Development

PHASE SENSITIVE RADIOMETER

Uwe Schilfkowitz and Wolfgang Finsterle



Figur 1. *Simulation of the non-equivalence for a standard PMO6 radiometer (dotted line) and the modified PMO6 cavity with thicker cylindrical walls and phase-sensitive signal analysis (solid line). Both curves show the excess heat loss to ambient air in the shutter-open state as calculated with the PMO6 simulator for two different thermal capacities of the cavity walls. The solid line was calculated with a cylindrical wall five times more massive.*

A new digital control unit for phase sensitive signal detection was designed and built by the electronics department. For test purposes this control unit was used with a standard PMO6-cc radiometer head. In order to optimize the mechanical design of the radiometer for phase-sensitive operations, a numerical heat transfer model was developed to simulate the temperature distribution inside the cavities (PMO6 simulator). The simulations were used to estimate the variability of the heat loss to ambient air in open and closed state, the so-called non-equivalence. The simulator was validated by comparing its non-equivalence to measurements in the laboratory. The simulated non-equivalence turned out to be about 0.3 %, which agrees well with the published values of a set of PMO6 type radiometers (Brusa and Fröhlich 1986).

The simulator was then used to optimize the constructional as well as operational parameters in order to minimize the effect of non-equivalence. By shortening the shutter cycle to 20 seconds (from a standard 180 seconds in classical PMO6 radiometers) the heat loss function is shifted with respect to the shutter cycle. The measurement error due to non-equivalence should thus be reduced in the phase-sensitive signal analysis. Unfortunately, the shift is small (12°) and reduces the measurement error only by a few percent. However, the PMO6 simulator allowed us to optimize the construction of the cavity to further reduce the error due to non-equivalence. We found that a five-fold increase of the thermal capacity of the cylindircal part of the cavity would reduce the non-equivalence by roughly 75 % (see Figure 1).

References: Brusa R.W. and Fröhlich C.: 1986,
Absolute radiometers (PMO6) and their experimental characterisation, Applied Optics 25, 4173.

CRYOGENIC SOLAR ABSOLUTE RADIOMETER (CSAR)

André Fehlmann, Wolfgang Finsterle, and Werner Schmutz in collaboration with Ulrich Straumann, University Zürich, Peter Blattner, METAS, Rainer Winkler, David Gibbs, and Nigel Fox, NPL, England

In order to establish strict traceability of the WRR to SI units, PMOD together with METAS (Wabern) and NPL (London) started a project to develop a cryogenic solar absolute radiometer (CSAR). Cryogenic radiometers serve as primary standards for radiant power (Martin et al. 1985). They are currently restricted to narrow beams of monochromatic (laser) light. The goal of the CSAR project is overcome these restrictions and to build a cryogenic radiometer capable of measuring direct solar irradiance. Two major challenges are to be tackled. First the characterization of the transmission of the entrance window to the vacuum tank and second the determination of the area of the precision aperture at low temperatures.

During the first year of the project several window materials were evaluated. An ideal window would equally transmit all wavelengths. This is obviously not possible (Figure 1). The transmission curves of real window materials always depend on the wavelength. Therfore a strategy to determine the window losses under varying atmospheric conditions had to be developed.

The window losses depend on the atmospheric conditions at the time of the measurement because the atmosphere affects the in-coming solar spectrum (Figure 2). A dual-cavity monitor radiometer working at ambient temperature was designed to measure the transmission coefficient of the entrance window (Figure 3). The monitor radiometer will be operated in parallel with the cryogenic radiometer. Both radiometers will be equipped with identical entrance windows. The monitor will determine the attenuation caused by the window relative to the unobstructed cavity. Because the monitor radiometer will perform relative rather than absolute measurements the drawbacks of ambient-tempertature radiometry are irrelevant. All multiplicative correction factors, such as reflectivity of the cavities or area of the precision aperture, will cancel out in relative measurements. Moreover, the monitor radiometer will be operated in passive mode. Hence the corrections for non-equivalence, lead heating, and the control loop electronics (CUI) also vanish. With all these sources of uncertainty eliminated we expect to measure the transmission of the entrance window to better than one part in 10^4.

It is planned to incorporate the CSAR in the WSG, which it might eventually replace. This would imply a paradigm shift from the artifact based primary standard (WSG) to the technology based standard (CSAR). Technology based standards link the unit of measurement to natural constants rather than defining the unit arbitrarly by use of an artifact. The CSAR will allow direct inter-comparisons of the WRR with primary standards at other National Metrology Institutes (NMI's). The participation in such so-called key-comparisons is a mandatory requirement for SI primary standards.

Reference: Martin J.E., Fox N.P., Key P.J.: 1985, A Cryogenic Radiometer for Absolute Radiometric Measurements, Metrologia 21, 147.

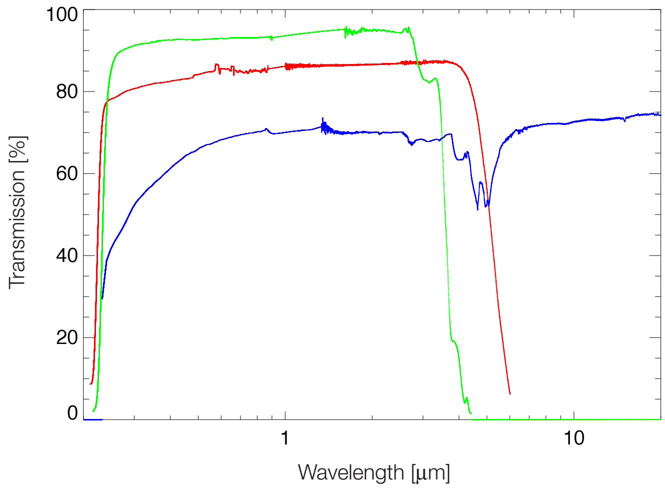


Figure 1. *Transmission curves for three different window materials. Quartz (green), Sapphire (red), and diamond (blue)*

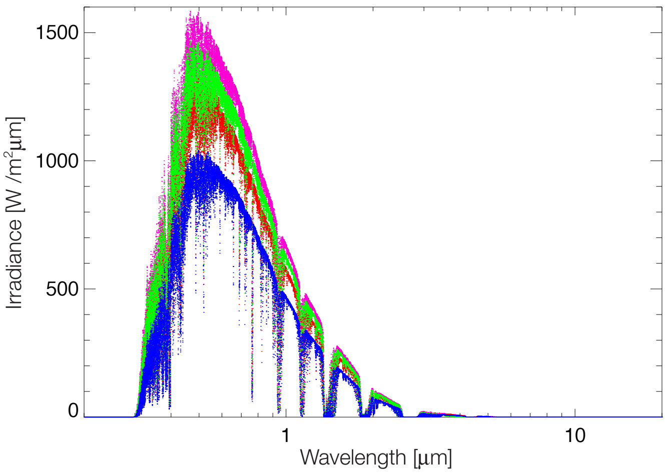


Figure 2. *The combined effect of the atmosphere (pink) and window materials (red, green, blue) on the in-coming solar spectrum.*

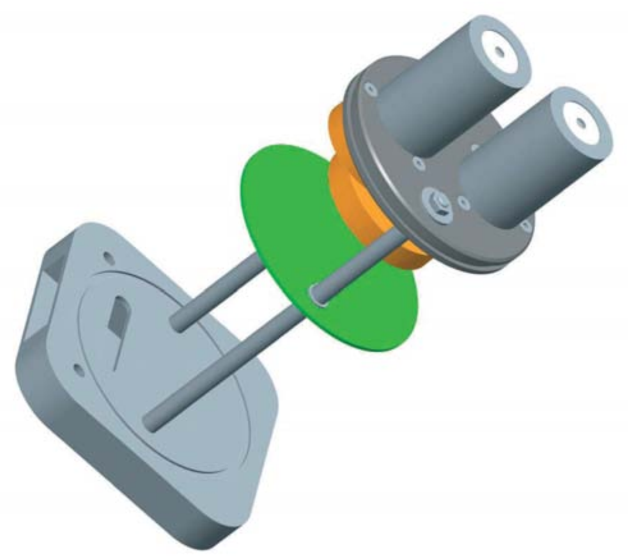


Figure 3. *Design of the monitor radiometer to assess the window transmission. One of the cavities can be "shaded" with an identical window as is used for the vacuum chamber that houses the cryogenic radiometer. The window losses (absorption and reflection) can be directly measured by the relative attenuation of the irradiance in the "shaded" cavity.*

Figure 1. *PREMOS Prototype ready for thermal vacuum test.*

PREMOS

PREMOS, a space experiment on the French PICARD micro satellite, is a collaboration with the French space agency (CNES) and the Centre National de la Recherche Scientifique, Service d'Aéronomie Paris (SA/CNRS). The PI and PI Institute of PREMOS is Werner Schmutz and PMOD/WRC, respectively.

The PREMOS prototype module has been thoroughly and carefully tested. The prototype consists of the entire structure with power supply, entire electronics, one of two radiometers PMO6 and one of three Filter radiometers and part of a cover mechanism with one actuator and motor (fully equipped, there will be 5 actuators and 5 motors for cover mechanics). The main goal of the prototype was to check the fitting of different elements and instruments in the structure and the entire functionality of the electronics and mechanics. To verify the thermal analysis conducted by a Swiss company, we constructed and tailored the thermal isolation and thermal shroud system. See photo "Thermal Test" on the left. With this test we detected, a relevant deviation between reality and theory of the thermal behavior of the instrument. As an outcome of this test we installed an additional heat pipe from the heat sink to the front plate of the package.

Furthermore, we delivered the unit to SA/CNRS Paris and to CNES Toulouse for mechanical, electrical and thermal interface tests with the satellite.

Manufacturing the flight model has used up most time in our mechanical workshop and the electronic department. The philosophy of the flight model is to have one spare in-

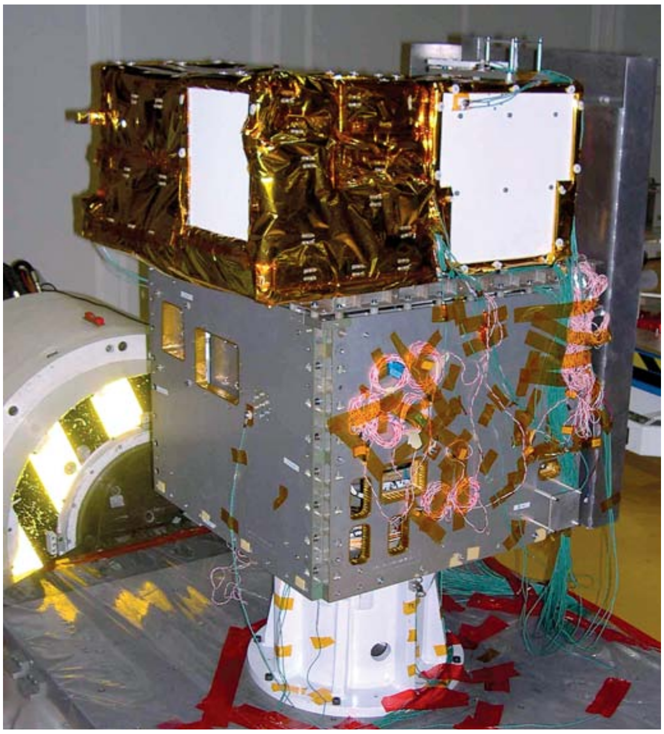


Figure 2. *PICARD satellite on the shaker table for launch simulation. PREMOS prototype mounted on the left hand side of upper part (payload). The satellite structure can be seen as a cube with dimensions of 1by 1 by 1m3 below the payload.*

Figure 3. *PREMOS Pachage partly assembled.*

strument available of every type. E.g. one additional absolute radiometer and one filter radiometer which have been tested completely will be ready for exchange if necessary. Redundancy of other units or subunits is not foreseen. Functional tests of instruments and electronics are ongoing, and integration of instruments into the package with full testing is planned at the beginning of 2008. Flight model delivery will be mid-May 2008, and the launch is scheduled for June 2009.

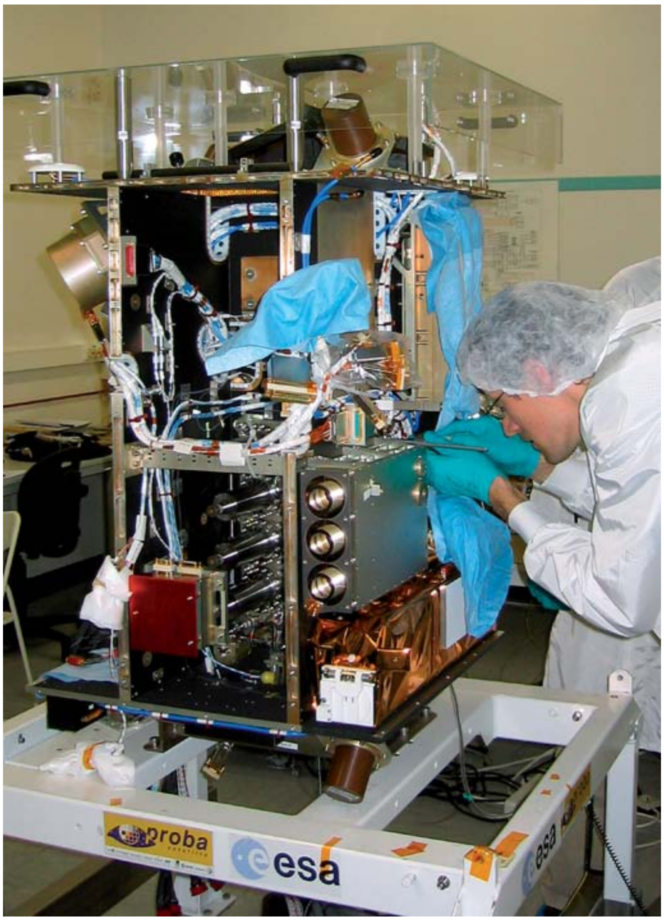


Figure 1. *Mounting of LYRA on PROBA-2*

LYRA

The LYRA (Lyman-Alpha Radiometer) flight unit was delivered to Verhaert Space, Belgium, at the beginning of March 2007. Verhaert Space is ESA's prime contractor for the PROBA-2 satellite. After bench tests in the Verhaert cleanroom, compatibility with the flight unit power supply (IIU) was verified. Finally, LYRA was mounted on the PROBA-2 structure wall. LYRA had to be co-aligned with the imaging instrument SWAP (Sun Watcher using APS detectors and image Processing). The integration period was rounded off with full functional health tests of the whole system SWAP, LYRA and IIU.

In June 2007, the Design Review Board Meeting was held at ESTEC, Holland as the last official meeting during the development phases. Although all major tasks for LYRA have been finished, PMOD has supported various functional and system qualification tests over the year concerning hard- and software. The launch of PROBA-2 was postponed again and is now foreseen for the end of 2008. Launch site is still Plesetsk, a cosmodrome in northern Russia.

SOVIM

In February, we conducted a vibration test with a newly manufactured sun shield. This test was performed at the University of Bern. In March, we attended a meeting at BUSOC, Brussels, to clarify procedures concerning the switching on and commissioning of SOVIM in space.

We delivered SOVIM to Thales Alenia Space in Cannes, France in March. An integrated EMC Test at Thales Alenia Space in Cannes was supervised during April. Later we visited SOVIM at Thales Alenia Space in Turin to conduct an electrical interface test.

The whole Solar platform was then shipped to Space Hub near Kennedy Space Center in Florida. The shipping was performed by Thales Alenia Space.

In September, we traveled to Florida to conduct the last voltage reference measurement. In October, the Solar platform was integrated on the ICC-light carrier, transferred to Kennedy Space Center, and then integrated into the shuttle payload bay.

The launch of space shutle STS-122 was originally scheduled for December 6, 2007. This launch was cancelled due to technical problems on the space shuttle and after several delays was shifted to February 7, 2008, when the shuttle Atlantis successfully docked at the International Space Station. Four days later the Solar platform was mounted on the upper side of the Columbus module.


Figure 1. *The Solar platform mounted on the ICC-Lite carrier at Space Hub, Florida.*

Scientific Research Activities

Global ozone and climate changes during the 20th century

Eugene Rozanov in collaboration with Andreas Fischer and Stefan Brönnimann IACETH, Zurich

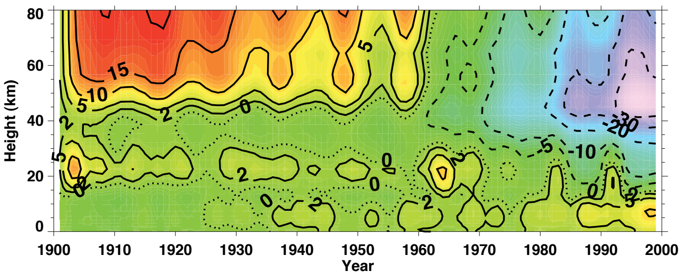


Figure 1. *Accumulated interannual difference (AID) of the global and annual mean temperature (K*10) from 1901 up to 1999.*

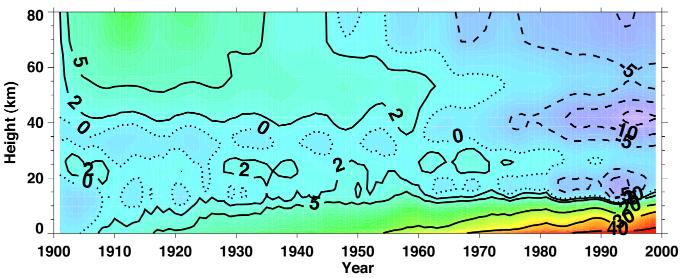


Figure 2. *Accumulated interannual difference (AID) of the global and annual mean ozone mixing ratio (%) from 1901 up to 1999.*

We analyse the changes of temperature and ozone during 20th century simulated with the chemistry-climate model (CCM) SOCOL and illustrate the influence of different natural and anthropogenic factors.

The 100-year long transient ensemble simulation with the CCM SOCOL spanning the entire 20th century has been carried out. The simulation was driven by the prescribed time evolution of the sea surface temperature, sea ice distribution, volcanic aerosols, solar spectral irradiance, greenhouse gases (GHG), ozone depleting substances, sources of CO and NO_x, land use, and quasi-biannual oscillation. To illustrate the model capacity to reproduce forced climate and ozone change we calculated the accumulated interannual difference (AID) of the global and annual mean temperature and ozone from 1901 up to 1999.

The temperature AID (in K*10) is illustrated in Figure 1. The warming due to GHG increase is clearly visible in the troposphere. It starts around 1940 and accelerates after 1985 reaching ~1 K in 1999. The warming in the upper atmosphere from 1901 to 1950 can be attributed to the solar activity, which was steadily increasing at that time. After 1950 the cooling of the upper stratosphere due to GHG increase and ozone depletion (see Figure 2) starts to dominate leading to much cooler (up to 4 K) stratosphere at the end of the century. The effects of volcanic eruptions appear as clearly visible warming spots in the lower stratosphere. The most pronounced warming occurs after the Santa-Maria (1902) and Agung (1963) eruptions, however some warming is also seen after the El-Chichon (1982) and Pinatubo (1991) eruptions.

The ozone AID (in %) is illustrated in Figure 2. The ozone change has two different tendencies: ozone depletion in the stratosphere due to increase of the chlorine and bromine loading and ozone enhancement in the troposphere due to increase of ozone precursor gases. The ozone depletion is the most pronounced during the second half of the century and reaches 15 % in the upper and lower stratosphere. The tropospheric ozone increase starts earlier and has larger magnitude. The slight ozone increase above 40 km during the first half of the century can be explained by the steady increase of the solar activity. The volcanic effects are visible in the lower stratosphere. The obtained results show that the model reproduces forced ozone and climate changes in 20th century reasonably well.

Development of the improved version 2.0 of the CCM SOCOL

Eugene Rozanov, Tatiana Egorova, and Werner Schmutz in collaboration with IACETH, Zürich

We present the improved version 2.0 of our CCM SOCOL and compare the total ozone and water vapor from two model versions against observations.

CCM SOCOL evaluations revealed several model flaws and led to the development of the CCM SOCOLv2.0. The new features of SOCOLv2.0 are: (i) the list of ODS was extended to 15; (ii) the heterogeneous chemistry module was updated; (iii) all considered species are transported; (iv) the mass-correction after semi-Lagrangian transport step is applied to the families instead of individual members and to ozone only over the latitude band 40°S-40°N; (v) water vapor removal by the highest ice clouds is now explicitly taken into account. The comprehensive description and evaluation of the CCM SOCOLv2.0 is presented by Schraner et al., (submitted, ACPD, 2008). For this new model version, most of the flaws described earlier have been eliminated or considerably reduced. In the region of the Southern polar vortex, modeled Cl_y and HCl are now much closer to the observations.

The total ozone distribution for both the CCM SOCOL versions is compared with SBUV/TOMS measurements in Figure 1. The simulated total ozone in v2.0 has been improved especially in spring over the mid-to-high latitude area in both hemispheres. It should be noted that the magnitude of the northern spring maximum and the shape of the total ozone distribution during boreal spring are still not perfect implying some remaining problems either with the transport module or relatively low horizontal resolution of the model, which could lead to an underestimation of the wave forcing and meridional circulation intensity.

Stratospheric water vapor, which was overestimated by 30-40 % in v1.1, is much improved in v2.0 by taking into account that clouds in the tropics and subtropics can also be formed above 100 hPa. Figure 2 illustrates the zonal mean H_2O mixing ratio distribution obtained from HALOE measurements and simulated with two model versions. The results show that H_2O simulated with v2.0 is much closer to observations, although values are slightly (~0.5 ppmv) underestimated mainly because of a cold bias (~ 3 K) at the tropical tropopause.

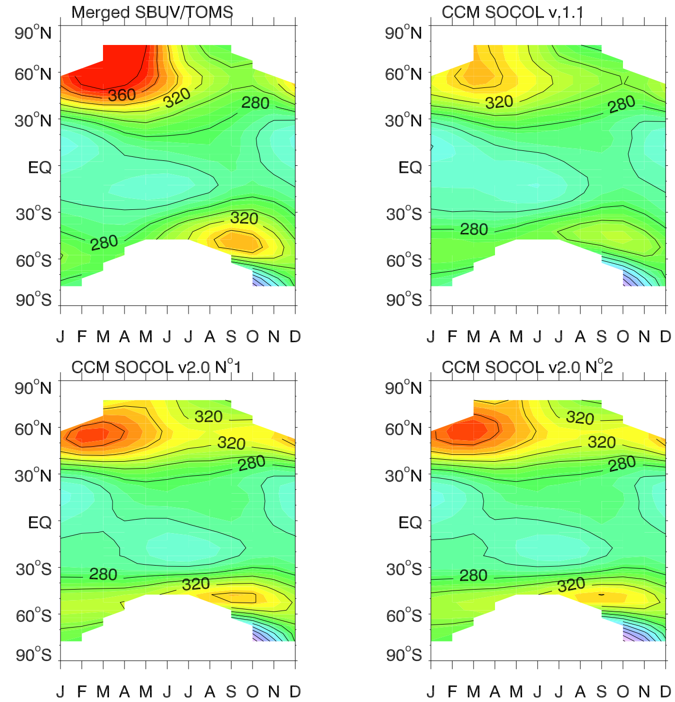


Figure 1. *Zonal mean total ozone (DU) from SBUV/TOMS data and two model versions. For v2.0 the results of two ensemble members are shown*

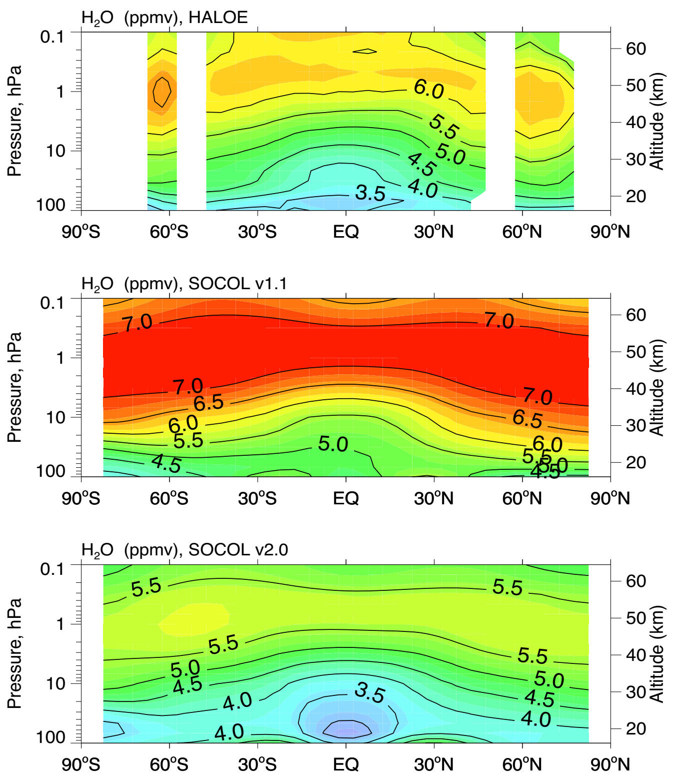


Figure 2. *Zonal and annual mean H_2O mixing ratio (ppmv) from HALOE data and two CCM SOCOL versions*

The solar signal in the stratospheric ozone and temperature in 20th century

Eugene Rozanov, Tatiana Egorova, and Werner Schmutz in collaboration with Andreas Fischer and Stefan Brönnimann, IACETH, Zurich

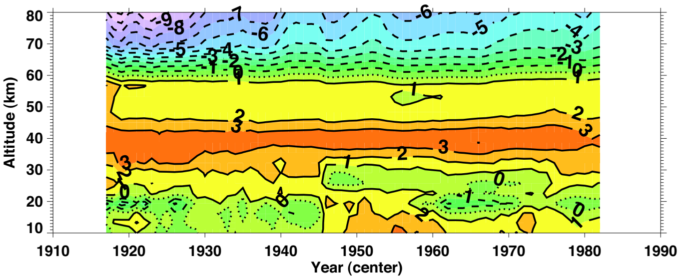


Figure 1. *Time evolution of the solar signal in tropical ozone (%).*

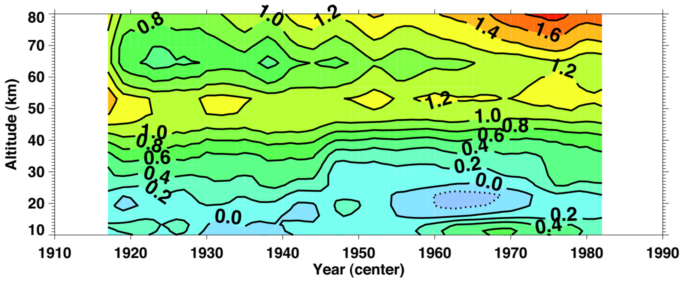


Figure 2. *Time evolution of the solar signal in tropical temperature (K).*

We extract the stratospheric ozone and temperature responses to the solar irradiance variability from the results of the 100-year long ensemble run of the CCM SOCOL and analyze their evolution in time.

It is important to understand the effects of different natural forcing and their dependence on the atmospheric state. To elucidate the influence of the solar irradiance variability we have carried out the 9-member 100-year long transient ensemble simulation with the CCM SOCOL spanning the entire 20th century, driven by the prescribed time evolution of the sea surface temperature, sea ice distribution, volcanic aerosols, solar spectral irradiance, greenhouse gases, ozone depleting substances, sources of CO and NO_x, land use, and quasi-biannual oscillation.

The simulated time series have been analysed by using a linear multiple regression technique to extract the ozone and temperature sensitivity to the solar irradiance variability. The solar signal in the zonal mean stratospheric ozone and temperature obtained from the entire time series (1901-1999) resembles the solar signal obtained earlier from the CCM SOCOL simulation covering the last 25 years of the 20th century.

To assess the time evolution of the solar signal we applied the same method consecutively to the 33-year long sub-series of the tropical mean ozone and temperature. The first sub-series is centred at 1918 and the subsequent time-series cover an entire century with a 1-year increment. Figure 1 shows the time evolution of the solar signal in the tropical ozone. The results reveal that ozone response to the solar variability is almost constant in the 35-60 km layer. In the mesosphere the magnitude of ozone response decreases significantly with time from ~9 % at the beginning to ~4 % at the end of the century. Ozone response also has a substantial time evolution below 35 km with a clear separation around 1945.

The same behaviour can be also seen in Figure 2 for the temperature response. It is rather stable in the 35-60 km layer, while its magnitude increases from 0.8 to 1.6 K in the mesosphere. Similarly there is a clear difference between the temperature response in the lower stratosphere during the first and second half of the century. The causes of such behaviour are not yet clear and their analysis is in progress.

Reconstruction of the solar irradiance for nowcasting of the middle atmosphere state on the basis of LYRA measurements

Tatiana Egorova, Eugene Rozanov, and Werner Schmutz in collaboration with ROB, Brussels, Belgium

We describe how to retrieve solar spectral irradiance from two spectral channels of the LYRA instrument and estimate the accuracy of the proposed approach using a 1-D model.

The LYRA instrument will only measure the solar irradiance at several wavelengths. To apply LYRA data to nowcasting it is necessary to reconstruct the full solar UV spectrum. We use daily solar UV irradiance for the year 2000 measured with the SUSIM instrument to calculate the solar irradiance for the LYRA channels and apply it to reconstruct the full solar UV spectrum using a linear regression technique.

Firstly, we calculate the correlations between the observed solar UV irradiance and different proxies. Ly-α and 205 nm proxies are the solar irradiances in the 121-122 nm and 204-205 nm bins. HERZ proxy is the solar irradiance in the Herzberg channel of the LYRA instrument. TSI is the total solar irradiance. F10.7 is the solar radio flux at 10.7 cm and NMD is the neutron monitor data. The correlation coefficients are shown in Figure 1. The reconstructions of the solar irradiance using Ly-α, 205 nm and HERZ proxies are more accurate than the reconstructions based on the F10.7 proxy. The TSI and NMD proxies do not allow realistic reconstruction of the daily solar UV irradiance variability. The best correlation can be reached using the LYRA proxy, which is a combination of HERZ and Ly-α.

To characterize the accuracy of the reconstruction we calculate the correlations between daily ozone concentration simulated with the observed and reconstructed solar spectral UV irradiance. The reconstruction of the spectrum using a linear regression equation based on the LYRA proxy can be successfully used for nowcasting of the middle atmosphere state above 40 km. The Ly-α proxy can be used in the mesosphere, HERZ and 205 nm give reasonable accuracy in the stratosphere, but the accuracy of the combined LYRA proxy is superior. The solar irradiance reconstructed from F10.7, TSI and NMD proxies does not provide reasonable accuracy.

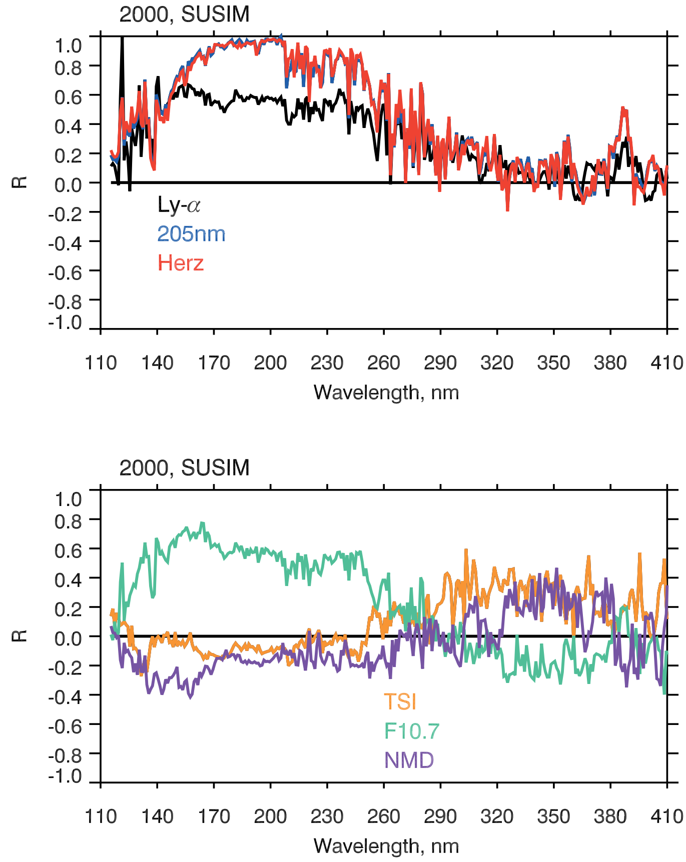


Figure 1. *The correlation between the daily observed spectral solar irradiance and different proxies.*

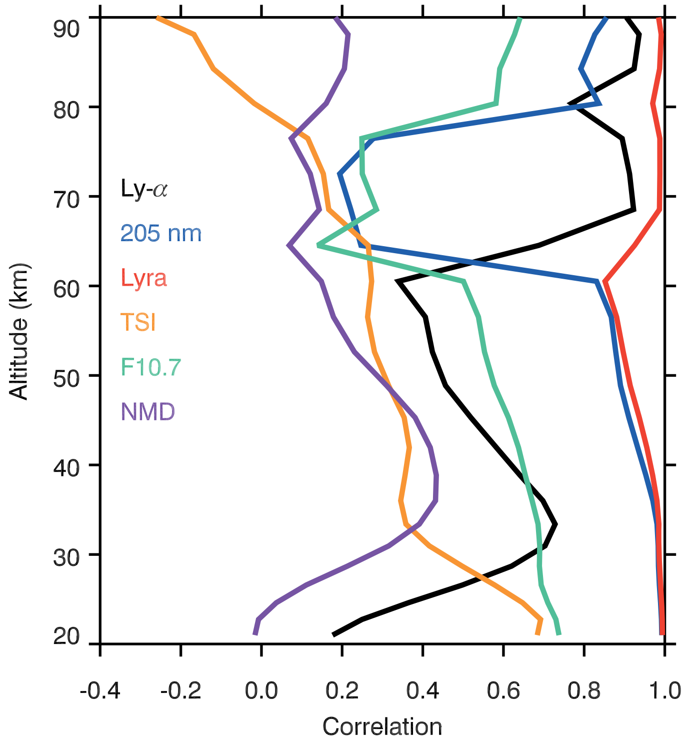


Figure 2. *The correlation between daily ozone calculated with observations and reconstructions from different solar irradiance proxies.*

The atmospheric effects of 2003 SPE simulated with chemistry-ionosphere-climate model SOCOL^{i}

Tatiana Egorova, Eugene Rozanov, and Werner Schmutz in collaboration with Y. Ozolin (MGO, St. Petersburg, Russia)

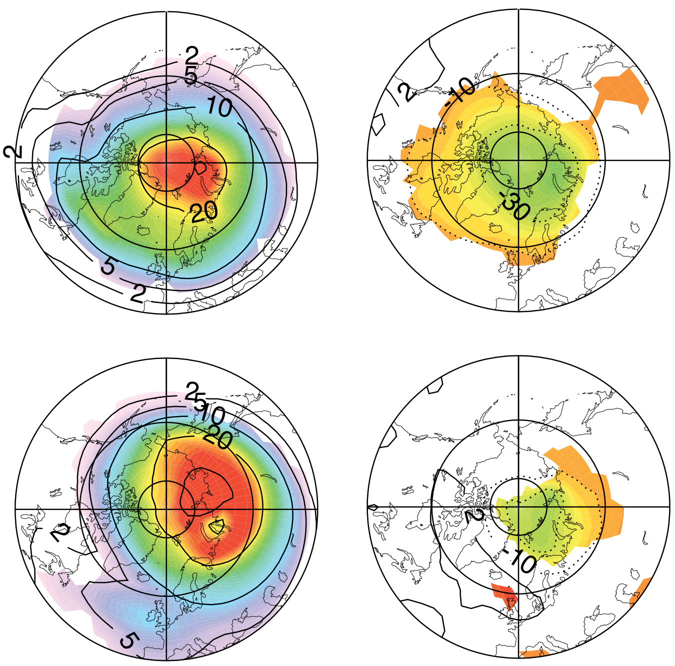


Figure 1. *Geographical distribution of NO_x (ppbv, left) and ozone changes (%, right) produced by SPE-2003 at 55 km for the days 302 (during the SPE, upper row) and 305 (after the SPE, lower row) in the Northern Hemisphere. Shaded areas show where the signal is statistically significant at a 95 % confidence level.*

We simulate the atmospheric effects of the October 2003 solar proton event (SPE) with our new 3-D chemistry-ionosphere-climate model SOCOL^{i}

SPEs can affect the chemical composition of the atmosphere and might cause temperature and dynamical changes. Hence, the simulation of SPE effects is possible only with a model that describes all relevant processes. The typical duration of SPEs is of about several days and its effects are strong enough to be clearly identified from observations. Thus, the simulation of the SPE effects is a convenient method for model validation.

Among observed SPEs the atmospheric effects of the October 2003 event are probably the best documented. Therefore, we have chosen this period to evaluate our chemistry-ionosphere-climate model SOCOL^{i}. In contrast to previous simulations of the atmospheric consequences of this SPE, which were based on parameterized NO_x and HO_x production, we applied the SOCOL^{i} model that includes a complete description of ion chemistry. The photochemical part of our model calculates the distribution of 43 neutral chemical species, electrons and 48 ions. The sources of the ionization are: galactic cosmic rays (GCR), energetic electron precipitation (EEP), solar UV radiation and SPEs. The daily ionization rates have been obtained from the SOLARIS website. We have carried out a pair of 2-month long SOCOL^{i} ensemble runs. The control run was uninfluenced by a SPE, while for the experimental run we included daily ionization rates due to the SPE. The SPE leads to the increase of total charge in both hemispheres. In the NH the magnitude of the effects is larger. For ions the effect from the SPE is not confined to the mesosphere, but also appears in the upper stratosphere. Enhanced HO_x and NO_x produced by the SPE leads to catalytic ozone destruction in the mesosphere. In the Northern Hemisphere the zonal mean ozone decrease exceeds 90 % in the upper mesosphere. In the stratosphere the model does not show statistically significant ozone changes. In the Southern Hemisphere the ozone decrease is smaller and reaches its maximum (~60 %) in the lower mesosphere. As for the Northern Hemisphere, we did not obtain statistically significant ozone changes in the stratosphere.

Figure 1 shows the geographical distribution of NO_x and O_3 changes. The model simulates a substantial increase (~40 ppbv) in NO_x mixing ratio at 55 km on day 303. NO_x enhancement is not uniformly distributed around the geomagnetic pole, it showed larger values inside the polar vortex. Ozone depletion is largest on day 303 (30 %) and decreases fast during the following days. Simulated NO_x and O_3 experienced a large perturbation during the SPE in October 2003, which is in accordance with observations.

Validation and operation of a tilted bottom cylindrical cavity used for pygeometer characterisation

Julian Gröbner and Daniel Bühlmann

The characterisation of pyrgeometers takes place in the laboratory by using blackbody cavities. The sensitivities derived with BB2007 are on average 1.0 % higher than the ones derived with BB1995 which is within the estimated uncertainties of the characterisation procedure.

A new tilted bottom cylindrical cavity was built at PMOD/WRC with the following specifications:

Inner diameter 150 mm
Height 900 mm
bottom inclination angle 30°
aperture diameter 100 mm
surface emissivity 0.9 (Aeroglaze Z302)
surface diffusivity less than 0.1

Based on Monte Carlo calculations by Prokhorov and Hanssen (2004), the hemispherical effective emissivity of this cavity is 0.99965. To determine the temperature distribution of the cavity, seven calibrated temperature probes are located at several positions along the cavity walls as shown in Figure 1. During routine operation of the cavity, the temperature gradients observed between the bottom (T1) and the aperture of the cavity (T7) are below ±0.15 K for temperatures between 240 and 290 K. The effective cavity temperature is obtained from the average of these temperature probes. The cavity was validated by comparing eleven pyrgeometers calibrated in this new cavity (BB2007), and the original cavity built in 1995 (BB1995). Figure 2 shows the relative differences in the sensitivities derived from each cavity. As can be seen in the figure, sensitivities derived with BB2007 are on average 1.0 % higher than the ones derived with BB1995.

Closer agreement can be obtained by slightly lowering the effective emissivity of BB1995 from its original value of 0.9985 to 0.9885, which might be related to an overestimation of the effective emissivity in the original calculations. Due to the optimal performance of the new cavity during the validation process, BB2007 will be used as the operational cavity for pyrgeometer characterisation at WRC-IRS as of January 2008. Scheduled intercomparisons between BB2007 and BB1995 will still take place on a yearly basis.

Reference: Prokhorov A. V. and Hanssen L. M.: 2004, Effective emissivity of cylindrical cavity with inclined bottom: I. Isothermal cavity, Metrologia, 41, 421-431.

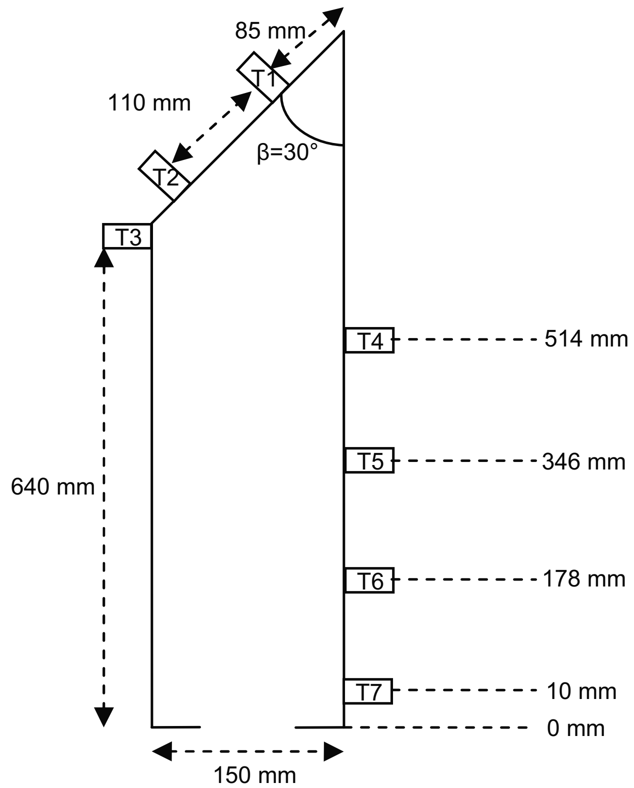


Figure 1. *Layout of the tilted bottom cavity BB2007.*

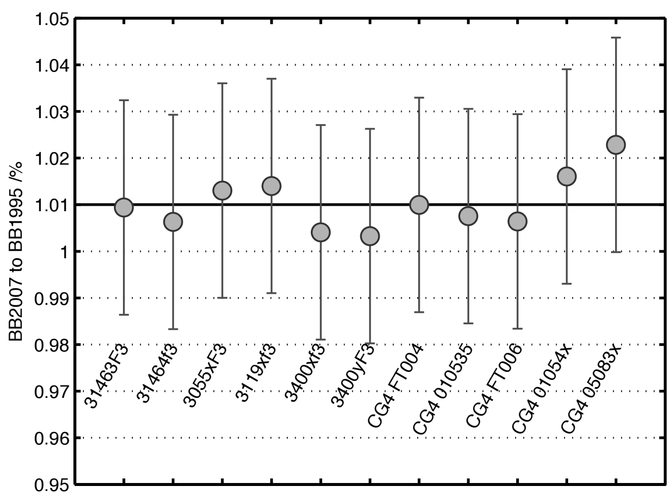


Figure 2. *Ratio between the sensitivity derived with the new (BB2007) and original cavity (BB1995) for eleven pyrgeometers. The error bar represents the combined calibration uncertainty of the two cavities of ±2.3 %.*

Strong Aerosol Optical Depth Decline over Europe

Rolf Philipona, Stephan Nyeki and Christoph Wehrli in collaboration with Christian Ruckstuhl, IACETH, Christian Mätzler, University Bern, Laurent Vuilleumier, MeteoSwiss, and Michael Weller, DWD, Germany

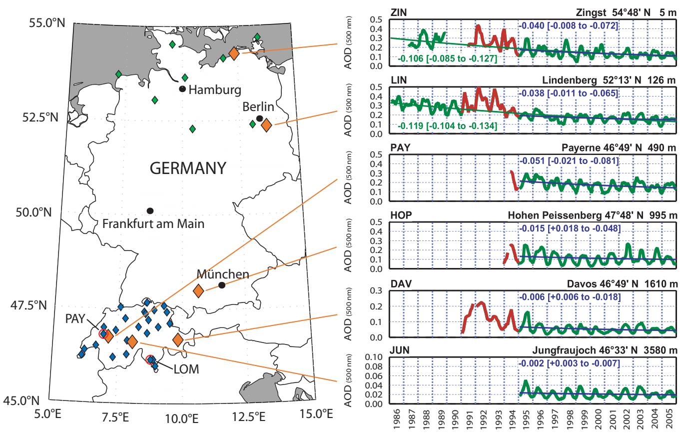


***Figure 1.** Locations of AOD observation sites in Germany and Switzerland (left, large diamonds). Monthly mean AOD are smoothed with a three month running mean and shown in green, except for the Pinatubo affected years 1991-1994 that are not included in trend analyses and are shown in red (right). Trends in AOD are given per decade and are shown for different time periods (below 1986-2005, above 1995-2005), while square brackets denote the 95 percent confidence interval.*

The longest series of spectral aerosol optical depth (AOD) measurements from the German Weather Service and MeteoSwiss were analyzed from six sites covering mainland Europe from the Baltic Sea to the Alps. The large aerosol decrease that is observed primarily at low altitude suggests declines that are due to reduced anthropogenic aerosol emissions. AOD has stabilized at low values since about 2000. A BAS type sun photometer was used at the German sites Zingst (ZIN), Lindenberg (LIN) and Hohenpeissenberg (HOP), and SPM2000 sun photometers and PFR precision filter radiometers were used at the Swiss sites Payerne (PAY), Davos (DAV) and Jungfraujoch (JUN). Considerable decreases of about 60 percent in AOD with statistically significant trends are observed at ZIN and LIN over the 1986 to 2005 measurement period. A statistically significant reduction between 20 and 30 percent is also observed for the 1995 to 2005 period at the three lowland stations ZIN, LIN, PAY. A decrease in AOD also occurs at the alpine stations HOP, DAV and JUN over the same period, but the decrease of only about 10 to 15 percent is not statistically significant due to lower absolute AOD and larger relative variability.

Increasing Solar Radiation due to AOD Decline

Rolf Philipona in collaboration with Christian Ruckstuhl, IACETH, Bruno Dürr, Laurent Vuilleumier, Antoine Zelenka, MeteoSwiss, and Klaus Behrens, DWD, Germany

Solar global or Shortwave Downward Radiation (SDR) from eight German and twenty-five Swiss radiation stations has been analyzed for all-sky, cloud-free and cloudy periods. The conclusion is that the long-term solar radiation increase over the period 1981 to 2005 is more affected by the direct aerosol effect than the indirect aerosol cloud effect. Annual means of all-sky solar irradiance (SDR_{as}) show increases from 1981 to 2005 (Fig. 1a) at the German (green) and Swiss (blue) sites. On average over all stations all-sky radiation shows a statistical significant increase of +2.99 Wm^{-2} dec^{-1} and is largely affected by the extreme year 2003. Without 2003 (Fig. 1c) the increase reduces to +1.95 Wm^{-2} dec^{-1} but still demonstrates "solar brightening" since the 1980s. Anomalies, with respect to the mean irradiance from 1981 to 2005, of cloud-free shortwave downward radiation (SDR_{cf}) show on average a statistically significant increase of +1.15 Wm^{-2} dec^{-1} between Germany and Switzerland (Fig.1b). This increase which is not affected by the year 2003 (see Fig. 1d) is strongly related to the 60 percent AOD decrease at low altitudes since 1986, demonstrating the direct aerosol effect. By subtracting SDR_{cf} from SDR_{as} anomalies we obtain the changes in shortwave downward radiation anomalies that are due to changes in cloud cover (SDR_{cloud}). SDR_{cloud} anomalies show large year-to-year variability and an average trend of +0.78 Wm^{-2} dec^{-1} without the year 2003.

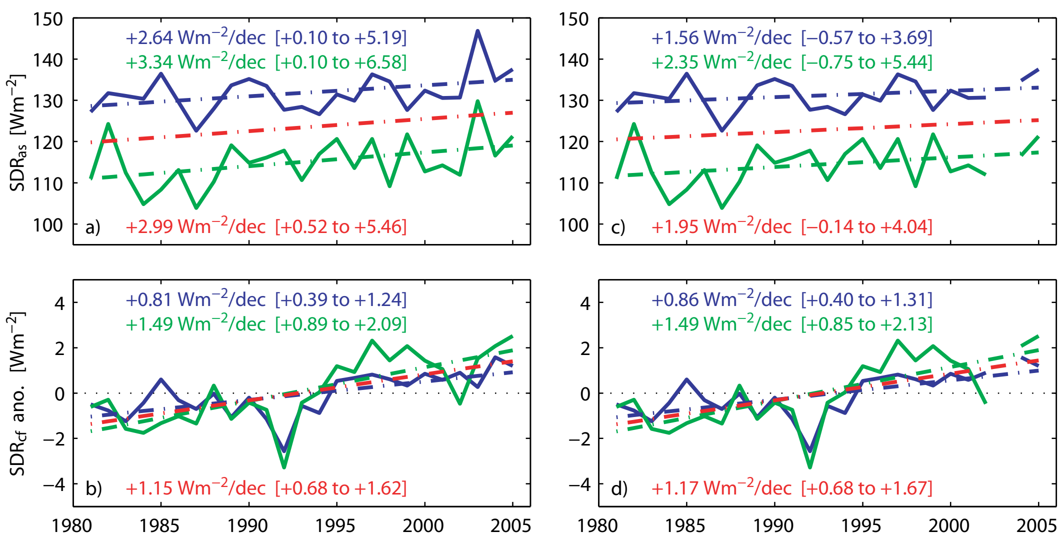


***Figure 1.** Time series of annual means from 1981 to 2005 (left with 2003, right without) of all-sky SDR (a and c) and anomaly of cloud-free SDR (b and d). Blue lines represent average values of the 25 sites in Switzerland, green represent average values of the 8 sites in Northern Germany, and the red line represents the average trend over all sites. Numbers indicate decadal trends in Wm^{-2} with the 95 percent confidence interval in square brackets.*

The GAWPFR aerosol optical depth network at baseline GAW stations

Stephan Nyeki, Christoph Wehrli, and Julian Gröbner

The GAWPFR Network has been measuring Aerosol Optical Depth (AOD) at baseline Global Atmosphere Watch (GAW) stations for about 8 years. An AOD climatology is beginning to become apparent which is discussed in this work. AOD is one of a number of important parameters required to assess and predict climate change (IPCC, 2007). In order to monitor AOD over the long-term and provide data of traceable quality, the World Optical depth Research and Calibration Centre (WORCC) was established in 1996 at PMOD/WRC, Davos by the WMO GAW program. Twelve existing GAW baseline stations were chosen for the deployment of PFR (Precision Filter Radiometer; PMOD/WRC manufacture) type sunphotometers. Quality controlled AOD data from this GAW-PFR network (www.pmodwrc.ch/worcc) are submitted by WORCC to the World Data Centre for Aerosols (WDCA; wdca.jrc.it). This work will give an overview of the latest AOD time-series at several GAW baseline stations.

AOD at 4 wavelengths (λ = 368, 412, 500, and 862 nm) is being measured at 12 GAW stations of which 2 have just recently been commissioned (Cape Point, South Africa; Mt. Waliguan, China). An overview of the available PFR AOD time-series (1-month mean) at several selected sites is shown in Figure 1. Measurements mostly began in the period 1999 – 2002, although the time-series extends further back to 1993 at Hohenpeissenberg, and to 1995 at Jungfraujoch (46.55°N, 7.99°E, 3580 m; not shown) using BAS and SPM-2000 type sunphotometers, respectively. Mean AOD (at λ = 500 nm) over the available time-series generally varies according to location type and site elevation. For instance, AOD is relatively low at ~0.02–0.05 at high elevation sites (Izaña and Mauna Loa) influenced by the free troposphere, although desert dust episodes (Sahara and Gobi deserts, respectively) can on occasion result in increased AOD. Higher AOD values are observed in the continental boundary layer, for instance ~0.11–0.12 at Alice Springs (continental desert) and Bratts Lake (continental prairie). Mean AOD at Ny Alesund (arctic tundra) appears to be relatively high at ~0.08. However, measurements are generally restricted to the sunlit and clear-sky March–August period, and are therefore biased by elevated aerosol concentrations in the December–April period. This is confirmed by in-situ aerosol black carbon measurements at Ny Alesund over the 1998–2007 period, where a factor 10 difference between winter and summer measurements has been observed (Eleftheriadis et al., 2008).

A trend analysis is currently being conducted. Any statement on medium to long-term trends is difficult to make at present due to the relatively short data sets. For instance, even if the apparent increase in minimum AOD at Hohenpeissenberg since 2004 is confirmed, whether changes in regional circulation or anthropogenic activity are causes would need to be further examined.

Apart from monitoring activities, WORCC has also developed a calibration hierarchy and is actively involved in comparisons of AOD across different networks. A field comparison of 4 AOD networks co-located at Bratts Lake, Canada demonstrated good agreement, which was well within the target uncertainty of AOD = ±0.005 + 0.01/airmass (McArthur et al., 2003). These and other inter-comparisons illustrate that the aim of achieving worldwide homogeneity in ground-based AOD observations has moved an important step closer.

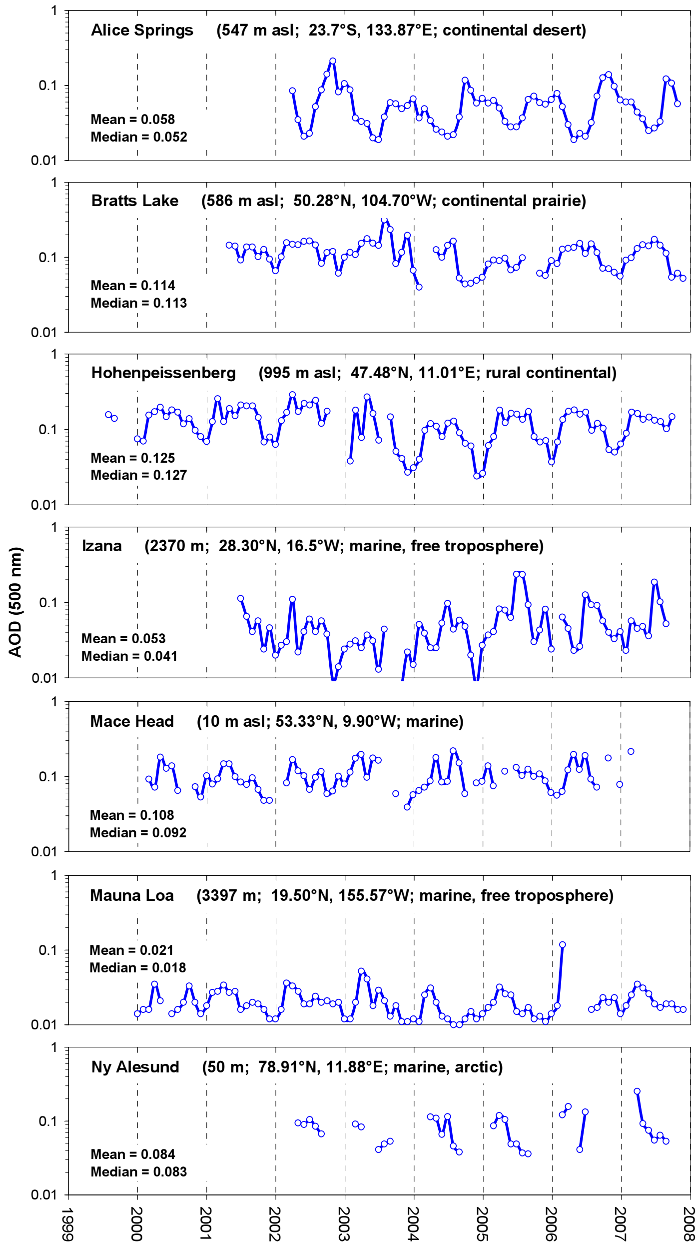


Figure 1. *One-month mean AOD at several representative GAW stations.*

References: Eleftheriadis K., Vratolis S., Nyeki S.: 2008, Aerosol Black Carbon in the European Arctic: Measurements at Zeppelin station, Ny-Ålesund, Svalbard from 1988–2007, to be submitted to Geophys. Res. Letters.

IPCC, Climate Change 2007, edited by Solomon S. et al., Cambridge Univ. Press, Cambridge, UK, and New York, USA, 2007.

McArthur L.J.B., Halliwell D.H., Niebergall O.J., O'Neill N.T., Slusser J.R., Wehrli C.: 2003, J. Geophys. Res., 108, D19, 4596.

Intercomparison of erythemal broadband radiometers calibrated by seven UV calibration facilities in Europe and the USA

Gregor Hülsen and Julian Gröbner in collaboration with UIIMP, LAP, INTA, NRPA, CUCF, STUK

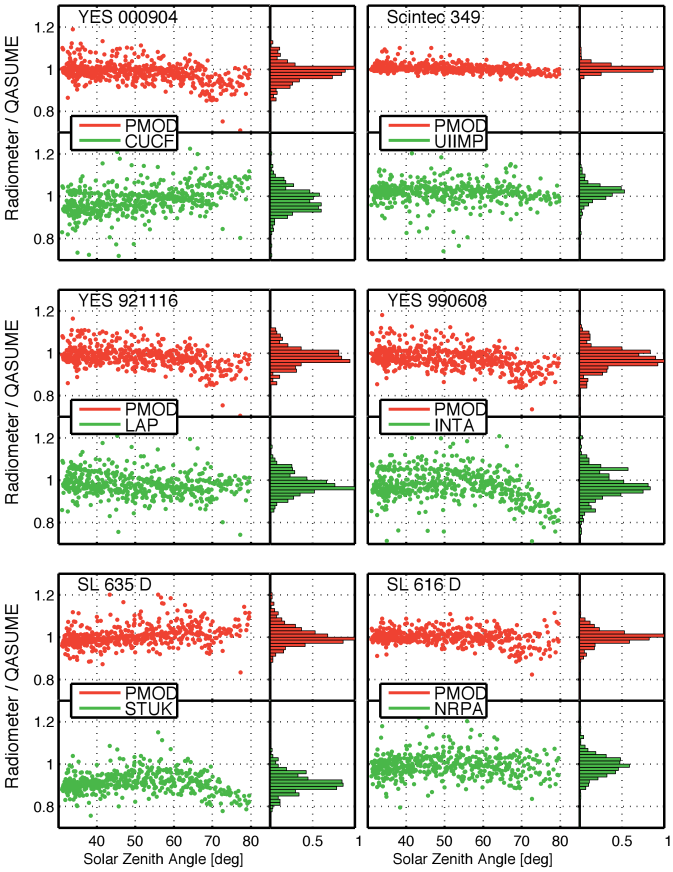


Figure 1. Erythemally weighted irradiances derived by the PMOD/WRC and the respective home institute relative to the QASUME spectroradiometer for the whole measurement campaign as a function of solar zenith angle. The right-hand side of each figure shows the corresponding residuals in bins of 0.015. The histograms are normalized to the largest bin in each figure.

An intercomparison of erythemal broadband radiometers was performed between seven UV calibration facilities. It is the first time that such a large-scale intercomparison of UV calibration facilities has been performed. The results of this study show the level of consistency currently achievable in the calibration of broadband UV radiometers measuring erythemally weighted UV radiation by different laboratories: nearly all calibrations of the six participating instruments are well within their estimated uncertainties. This effort fits within the declared goal of the WMO-GAW strategic plan 2008-2015 to link UV calibration services in different regions.

In the study the owners calibrations were compared to the characterisation and calibration performed at PMOD/WRC in Davos, Switzerland. The calibration consisted in the determination of the spectral and angular response of the radiometer, followed by an absolute calibration performed outdoors relative to the QASUME spectroradiometer which provided the absolute reference.

The characterization of the detectors in the respective laboratories were found to be in good agreement, especially concerning the determination of the angular response, with deviations within ±4 % in the calculated cosine error. The larger differences observed in the spectral response functions is due to the differences in the laboratory setups. However the differences do not introduce any significant discrepancies in the resulting calibration apart from one case. A 'blind' intercomparison of the erythemally weighted irradiances derived by the respective institutes and PMOD/WRC showed consistent measurements to within ±2 % for the majority of institutes. Only one institute (STUK) showed slightly larger deviation of 10 %. The absolute calibration of the spectroradiometers, which are used to calibrate the erythema detectors, has an uncertainty within ±5 %.

Summary of the COST Action 726 project: Quality assurance of solar UV filter radiometer networks

Gregor Hülsen and Julian Gröbner

Introduction: The main objective of the COST Action 726 is to advance the understanding of UV radiation distribution under various meteorological conditions in Europe in order to determine UV radiation climatology and assess UV changes over Europe. Within the framework of the activities of working group four of the action, a two year project was established to enhance quality assurance of solar UV filter radiometer networks.

Project activities: The main goal of the project was to homogenize solar UV measurements across Europe. The first task was to develop and establish a UV calibration facility at PMOD/WRC for the characterization and calibration of UV radiometers. The laboratory now has a UV angular and spectral reponse setup (Figs. 1 and 2). On the roof of the institute a large calibration platform was constructed which can accomodate around 30 filter radiometers for the absolute calibration. The necessary calibration procedures were developed (Hülsen et al., 2006). In August 2006, a large-scale calibration and intercomparison campaign of radiometers measuring erythemally weighted solar irradiance was organized at PMOD/WRC. The analysis of this campaign showed that the original calibration of the majority of the reference broadband radiometers across Europe is within the uncertainty of the new calibration. However several instruments had to change their calibration factors by up to 50 %.

A further task of the project was the establishment of a UV reference at PMOD/WRC. This reference consists of two types of instruments, spectroradiometers and broadband radiometers. The former consists of the transportable reference spectroradiometer QASUME and a Brewer #163 spectrophotometer. The later is a triad of radiometers, where each instrument is choosen from a different manufacturer – Yankee Enviromental Inc., Solar Light and K & Z (Fig. 3).

During the two years of the project the spectroradiometer QASUME was used to homogenize solar UV measurements with site audits at six European institutes monitoring spec-

Figure 1. Setup in the UV laboratory for measuring angular response.

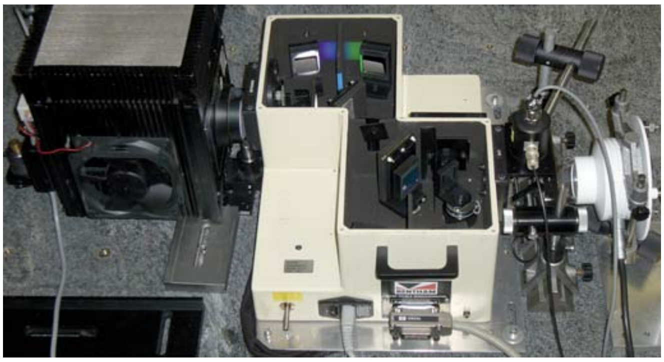


Figure 2. Setup for the spectral response.

tral solar UV radiation. In September 2007 the spectroradiometer joined the 2nd RBCC-E campaign at El Arenosillo, Spain (Fig. 4). The reports of these campaigns will be available on the PMOD/WRC web-site. The QASUME spectroradiometer acted as the European UV reference for the 16 Brewer spectrophotometers and 23 UV broadband radiometers which participated in this campaign.

A key activity in 2007 was the analysis of the results from the COST 726 measurement campaign held in 2006 and the production of the final report of this activity, which can be found on the COST 726 web-site (Gröbner, et al., 2007). This campaign also allowed the calibration performance from seven international UV calibration laboratories to be compared (Hülsen et al., 2008), a task which has been promoted by the CIMO Expert Team on Meteorological Radiation and Atmospheric Composition Measurements as well as the GAW SAG UV.

Conclusion: The PMOD/WRC has established a European UV calibration center (EUVC) in Davos, Switzerland. A novel calibration methodology has been introduced, which takes the angular response function and the spectral response of the broadband radiometer explicitly into account. The typical uncertainties of broadband radiometers measuring erythemally weighted solar irradiance were investigated using results from the PMOD/WRC-COST 726 campaign held in August 2006 in Davos, Switzerland. It could be shown that well maintained and stable radiometers could be calibrated with an expanded uncertainty of 7.2 %.

Spectral solar irradiance measurements performed from European institutes were audited during visits with the transportable reference spectroradiometer QASUME.

Outlook: The EUVC has reached its operational state and will continue to serve as a reference calibration center for the homogenization of UV measurements in Europe. Continuous calibrations of UV instruments will enhance the quality of ground based UV products. The instrumentation of the EUVC will also be used for further scientific investigations of solar UV radiation. Since January 1, 2008, the PMOD/WRC UV calibration center has been recognized as a GAW regional UV calibration center for Europe (WMO RA VI).

Figure 3. The roof-platform of PMOD/WRC showing the UV broadband radiometer reference triad among others.

Figure 4. 2nd RBCC-E campaign in El Arenosillo, Spain, with the transportable spectroradiometer QASUME acting as UV reference instrument.

References:

Hülsen G. and Gröbner J.: 2006, Characterization and calibration of ultraviolet broadband radiometers measuring erythemally weighted irradiance, Applied Optics, Volume 46, 5877-5886.

Gröbner J., Hülsen G., Vuilleumier G. L., Blumthaler M., Vilaplana J. M., Walker D., Gil J. E.: 2007, Report of the PMOD/WRC-COST Calibration and Intercomparison of Erythemal Radiometers, http://i115srv.vu-wien.ac.at/uv/COST726/COST726 Dateien/Results/475 PMOD WRC COST 726 campaign 2006 R.pdf.

Hülsen G., Gröbner J., Bais A., Blumthaler M., Disterhoft P., Johnsen B., Lantz K. O., Meleti C., Schreder J., Vilaplana Guerrero J. M., Ylianttila L.: 2008, Intercomparison of erythemal broadband radiometers calibrated by seven UV calibration facilities in Europe and the U.S.A., Atmos. Chem. Phys., Discuss., 8, 2249-2273.

Longwave Infrared Radiative forcing trend Assimilation over Switzerland (LIRAS)

Julian Gröbner and Stefan Wacker

Figure 1. CGR3 pyrgeometer at Locarno-Monti (Foto: N. Gobbi).

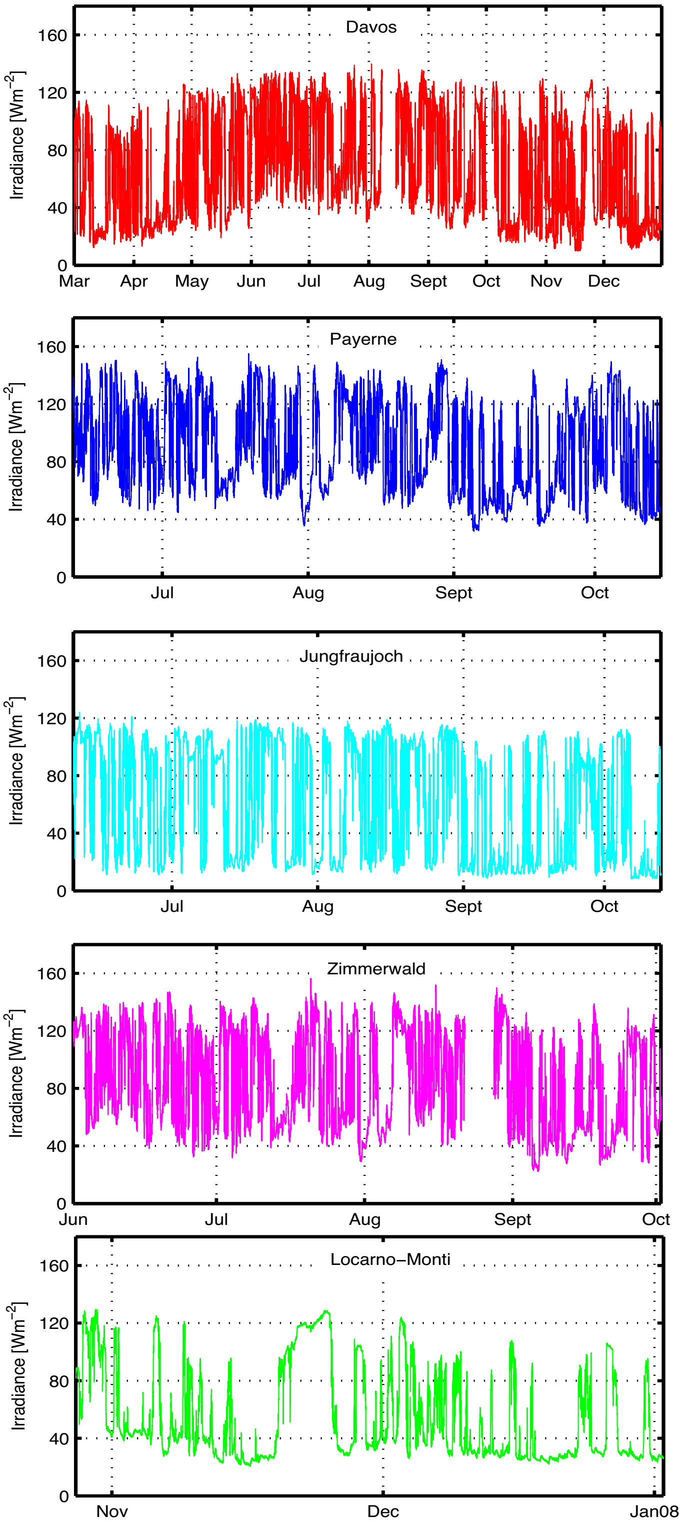


Figure 2. CGR3 measurements at five stations in 2007.

The LIRAS project aims to investigate downward long-wave infrared radiation (LIR) measurements during 1994–2009 from four stations in Switzerland: the global GAW station Jungfraujoch, the BSRN station Payerne, the Swiss MetNet station Locarno-Monti and the PMOD/WRC at Davos. The objective is to produce consistent and quality assessed trend estimates of LIR through the assimilation of this large ancillary data set using Radiative Transfer Models (RTMs) and statistical tools.

Radiative transfer calculations will be used for specific sensitivity studies and for the quantification of different forcing mechanisms. The combined application of numerical and statistical models will allow us to separate the trends in the observed LIR induced directly by an increase in anthropogenic greenhouse gases (AGHG) and indirectly by changes in temperature, clouds and water vapor due to changes in the atmospheric state. This approach will be validated by the identical analysis of LIR trends from the multi-model simulation performed in the framework of the IPCC fourth assessment (4AR), where the direct forcing by AGHG is known.

In parallel to this activity, modified CGR3 pyrgeometers sensitive in the 8-14 μm window (the main atmospheric window), will be installed at all four stations. An additional CGR3 pyrgeometer will be deployed at Zimmerwald, located close to Berne. The sensitivity of these instruments to the radiative forcing due to water vapor and clouds will be higher than for standard instruments allowing the separation of the parameters responsible for the observed LIR changes with higher accuracy.

The CGR3 pyrgeometers were calibrated and tested in spring 2007 at PMOD/WRC. Afterwards they were installed at the five stations. Data acquisition started between March and October depending on the station (see Figure 2).

Because a slight drift in the measurements at Davos was observed, two CGR3 pyrgeometers were recalibrated in summer 2007 revealing a change in the coefficients of nearly 10 %. As a consequence, all CGR3 pyrgeometers were returned at the end of 2007 for recalibration. The results showed that the change in the coefficients had decreased to approximately 1 %. The instruments will be deployed at all stations again at the beginning of 2008.

Concerning RTMs, a comparison between different models and measurements at Payerne was performed. Nine clear nights in summer 2007 were selected.

Longwave Downward Radiation (LDR) measurements were provided by a broadband pyrgeometer and a CGR3 pyrgeometer. The model calculations were conducted with the radiative transfer models SBDART, libRadtran-1.3 and MODTRAN v4.1 over the same wavelength range as the measurements. Vertical profiles of pressure, temperature and humidity were deduced from radiosondes launched from Payerne.

Solving the discrepancy between the seismic and photospheric solar radius

Margit Haberreiter and Werner Schmutz in collaboration with Sasha Kosovichev, Stanford University, USA

The solar radius is determined with two methods: Observations of the intensity profile at the limb, or by using f-mode frequencies to derive a 'seismic' solar radius. The two methods lead to results which differ by ~0.3 Mm. In a paper in press in the Astrophysical Journal Letters we explain the difference as an effect of the increased optical depth along the line of sight at the limb which makes the Sun appear larger to an observer who measures the extent of the solar disk.

Based on radiative transfer calculations we show that the discrepancy of the radius values obtained with the two methods can be explained by the difference between the height at disk center where τ_{5000}=1 (τ_{Ross}=2/3) and the inflection point of the limb intensity profile. We calculate the limb intensity profile for the MDI continuum and the continuum at 5000 Å for two atmosphere structures (Fontenla and Kurucz) and compare the position of the inflection points with the radius at τ_{5000}=1 (τ_{Ross}=2/3). The calculated difference between the 'seismic' radius and the inflection point is 0.347±0.06 Mm with respect to τ_{5000}=1, and 0.333± 0.08 Mm with respect to τ_{Ross}=2/3. We conclude that the standard solar radius in evolutionary models, which commonly refers to τ_{Ross}=2/3, has to be lowered by 0.333± 0.08 Mm and is 695.66 Mm. This correction reconciles inflection point measurements and the 'seismic' radii within the uncertainty. The result shows that the solar community has to agree on a binding definition of the solar radius. Here we suggest the solar radius should refer to τ_{Ross}=2/3. The study of the wavelength dependent position of the inflection point with respect to τ_{Ross}=2/3 is essential for the upcoming space project PICARD.

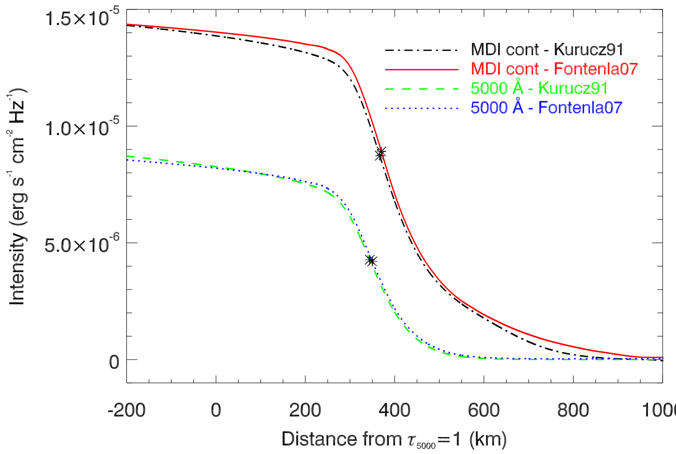


Figure 1. *Mean intensity variation at the solar limb for the MDI continuum, applying all five MDI filter functions, and the continuum at 5000 Å calculated with the LTE (Kurucz) and NLTE (Fontenla) model atmosphere structures. Height zero refers to the 'seismic' solar radius 695.68 Mm. The crosses indicate the position of the inflection point of the intensity profile.*

NLTE calculations of the solar atmosphere with iterated opacity distribution functions

Margit Haberreiter and Werner Schmutz in collaboration with Ivan Hubeny, University of Arizona, USA

In a paper submitted to Astronomy and Astrophysics we present the radiative transfer code COSI (Code for Solar Irradiance), which allows the calculation of realistic solar spectra in the UV wavelength region. We present a new computational concept that we term iterated opacity distribution functions (NLTE-ODFs).

In the UV wavelength range the usual assumption of local thermodynamic equilibrium (LTE) to calculate radiation transfer in the solar atmosphere does not hold. Thus, to calculate the solar spectrum in the UV non-LTE effects have to be taken into account. With COSI we calculate only a limited number of line transitions between selected explicit atomic levels in NLTE, all other transitions are treated in LTE. Thus, the line opacity of a high number of lines is not directly included in the solution of the NLTE radiative transport. Indirectly we account for them by applying opacity distribution functions (ODFs) of the LTE line opacities. Thus the inclusion of the ODFs changes the line strengths of the emergent spectrum, which in turn leads to a different set of ODFs. Therefore, self-consistent ODFs can only be calculated iteratively. Figure 1 shows the effect of the ODFs on the continuum in the UV. The increased opacity leads to a decrease of the continuum flux, which in turn leads to a decrease of the ionization of the atoms. Only the inclusion of all line opacities allows the calculation of correct spectra in the UV.

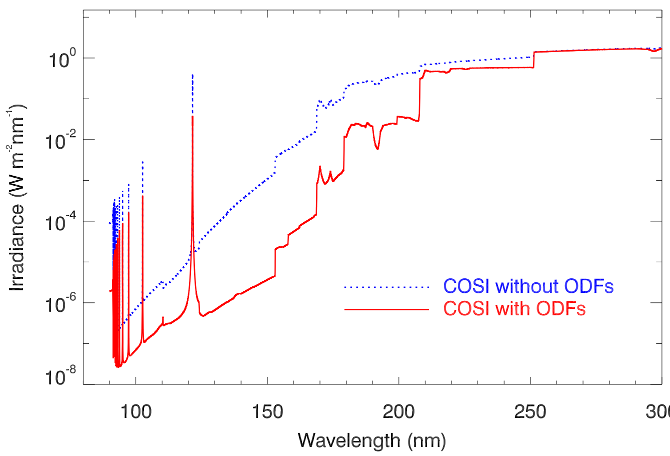


Figure 1. *Continuum spectrum for UV calculated with COSI with (solid line) and without (dotted line) ODF. The implemented ODFs lead to a considerable decrease of the continuum flux, which in turn leads to less ionization.*

Influence of the magnetic canopy on the dispersion relation of magnetoacoustic waves in the solar atmosphere

Margit Haberreiter and Wolfgang Finsterle

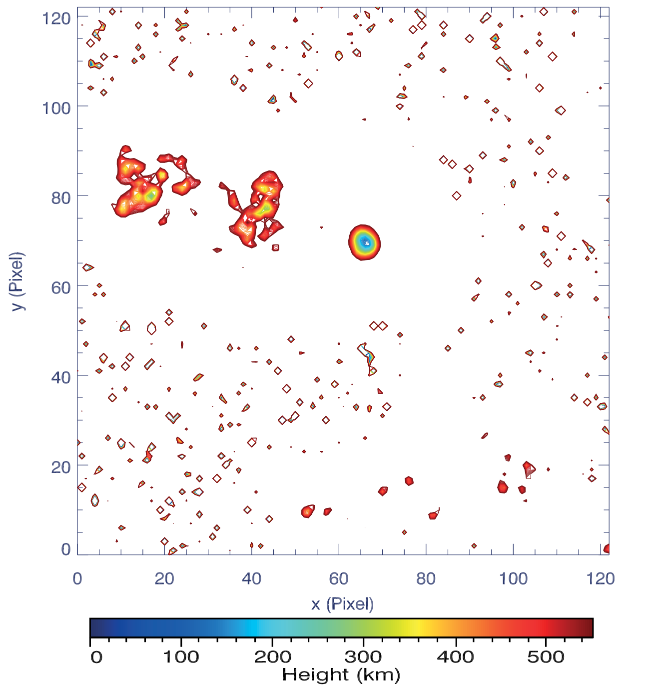


Figure 2. *Contours where the magnetic canopy is below the Na I 5890 Å formation height in plage. The height scale is with respect to h(τ_{500})=1. The areas where the β=1 layer is below the Na I 5890 Å formation height coincide with areas of higher phase travel time in Figure 1a. The white color indicates that the β=1-layer is above the formation height of Na I 5890 Å.*

Reference: McIntosh S. W., Bogdan T. J., Cally P. S., et al. 2001, ApJ, 548, L237

Solar acoustic eigenmodes were found to leak into the solar atmosphere in magnetized areas where they might contribute to the chromospheric heating. We found strong indications for mode conversion being the mechanism that allows the eigenmodes to escape the internal acoustic cavity of the sun. Recently, the observation and analysis of upward traveling waves in the solar atmosphere has become of great interest, as they are thought to provide a considerable amount to the heating of the chromosphere. Commonly it was understood that only waves with frequencies above the acoustic cut-off frequency, ν_0, could travel freely in the solar atmosphere, whereas waves with lower frequencies are trapped inside the acoustic cavity of the Sun. However, recent studies reveal upward traveling waves with frequencies $\nu<\nu_0$ in magnetic areas (Figure 1a). Here we propose that these traveling low-frequency waves are excited by sound waves that undergo mode-conversion at the magnetic canopy, i.e. the layer where the magnetic pressure equals the gas pressure (plasma β=1). To test this hypothesis we use magnetic field extrapolations (McIntosh et al. 2001) of the MDI magnetogram in Figure 1b to estimate the height of the magnetic canopy in the model atmosphere structures. Furthermore, from radiative transfer calculations carried out with COSI we determine the formation height of K I 7699Å and Na I 5890 Å for the quiet Sun and plage. Figure 2 shows the colored contours of the calculated β=1-layer below the Na I 5890 Å observing height for plage. The red contours indicate where the β=1-layer coincides with the observational height of Na I 5890 Å. Towards the center of the active regions the β=1-layer drops and reaches heights lower than the observational height of K I 7699Å (green to blue contours). The striking congruence of the areas where waves propagate (Figure 1a) and where β=1 cuts through the MOTH observing layers supports our assumption that the low-frequency waves only travel in magnetic regions.

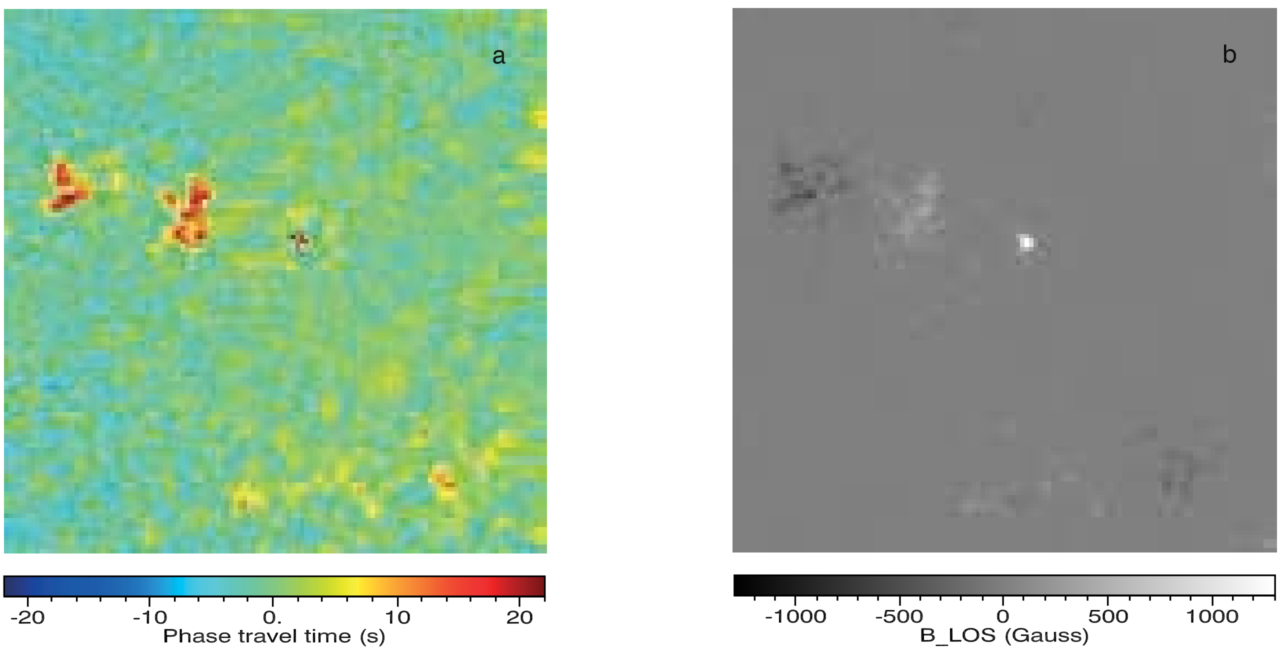


Figure 1. *Phase travel time map (455 Mm x 455 Mm at disk center) for waves with frequency ν=3.0 mHz (a) and the concurrent MDI magnetogram (b). The yellow and red pixels indicate upward traveling waves with phase travel times up to 22 s, coinciding with magnetic regions in the MDI magnetogram, whereas the phase travel time for the non-magnetic areas is approximately zero.*

Reconstructing the Spectral Solar Irradiance: The Active Area Expansion

Micha Schöll and Werner Schmutz

We present a new method to reconstruct the spectral solar irradiance by utilizing the formation height of the spectral lines and continuum and an increase in active area over height. This leads to a more realistic model of the irradiance specifically in the extreme UV.

Solar irradiance variation is an important forcing component in climate models as it is known that the climate reacts to a changing solar irradiance. As Rozanov et al.(2002) has shown, the Lyman-α is of particular importance to chemical reactions in the upper atmosphere.

To reconstruct the climate of the past, spectra as a function of time are needed. Following the approach of Wenzler et al. (2005) and Krivova et al. (2005) the spectral reconstruction is based on a four component model with filling factors for the area of quiet sun, sunspots, plague and network. Wenzler extracts the filling factors using MDI magnetogram data and images of the visible sun.

This model works well for modeling the total solar irradiance. However, it does not well reproduce the variability in the extreme UV (EUV) spectrum, notably the Ly-α emission line at 1215.6 Angstrom. Using Non-LTE calculations improves the model significantly. However Haberreiter et al. (2005) still fails to reproduce the Ly-α variability by a factor of two. We present a new method to reconstruct the spectrum of Ly-α by introducing a modification to the filling factor or the active regions.

The photosphere is a 300 km thick layer of the sun where the visible part of the spectrum is formed. Its average temperature is about 6000 K. Above the photosphere lies the chromosphere and the transition region to the corona with temperatures up to 1 Mio.°C. The formation height of the EUV differs from that of the visible part of the spectrum. The visible light is formed in the photosphere while the EUV and lines are formed under hotter temperatures in the chromosphere. Figure 1 shows the Ly-α formation height, which is several thousand kilometers above the photosphere. A widening of the active area with respect to height above the photosphere is evident, when looking at images of the sun.

From images extracted from the SOHO SUMER instrument (Figure 2), a high-resolution spectrograph with imaging capabilities, an increase in the active area of about a factor of two compared to MDI magnetograms is observed. As a first approximation of the area expansion over height, a quadratic function of the area is constructed. The constraints are an expansion factor of unity at the photosphere and an expansion factor of two for the active area at the Ly-α formation height. This results in the model shown in Figure 3. We apply this area enlargement to all wavelengths of the spectrum by calculating the corresponding factor from the formation height of optical depth unity at this wavelength. The result are frequency dependent filling factors $\alpha(\lambda,t)$ leading to a more accurate spectral solar irradiance in the EUV region. This new filling factor is used to reconstruct the spectrum. From this work in progress we show the reconstructed Ly-α compared to measurements in Figure 4.

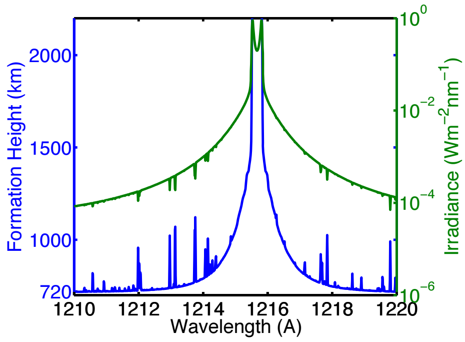


Figure 1. *Left: Formation Height of the corresponding wavelength. The Ly-α goes up to 2000 km above the photosphere and the EUV continuoum in this region is about 800 km above the photosphere. Right: Spectral Irradiance in $Wm^{-2}nm^{-1}$ of the quiet sun Ly-α.*

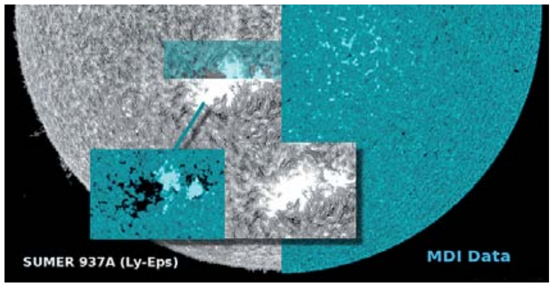


Figure 2. *Comparison of SUMER 937A (left, Ly-ε, SUMER ATLAS) with MDI magnetogram data (right, SOHO Datacenter).The SUMER pictures show an increase in area of about a factor 2.*
Images from SUMER ATLAS and SOHO Data Archive.

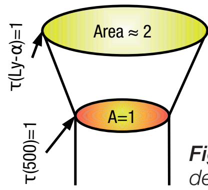


Figure 3. *Schematic representation of the altitude dependent active area enhancement factor.*

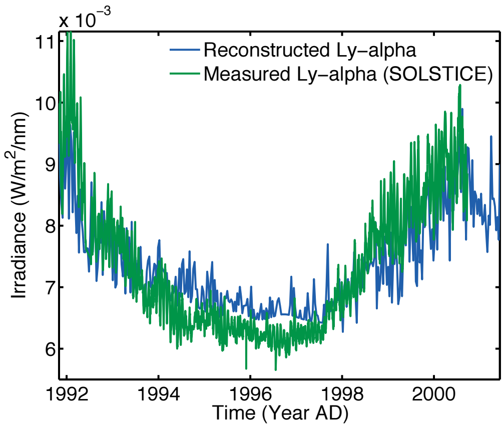


Figure 4. *Reconstruction of the Ly-α over time using both the active area expansion and the network. The variability of the reconstructed Ly-α is within 75 % of the measured one.*

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Modeling of the global ozone and climate evolution in the first half of the XXI century

I. Karol, A. Kiselev, Y. Ozolin, I. Rozanova, O. Syrovatkina, V. Zubov (MGO, Sankt Petersbrurg, Russia) in collaboration with PMOD/WRC (supported by SNSF SCOPES grant IB7320-110884)

The statistical and synoptic studies of the temperature and circulation regimes of the winter Arctic lower stratosphere and the stratospheric ozone zonal transport in the subarctic latitudes were completed. The paper describing the obtained results has been published in the Russian journal "Meteorologia and Gidrologia" №2. 2008. Monthly mean total ozone data from the Russian ground stations for the years 1973-2006 have been processed using advanced Linear-Discriminant Analysis. The quantitative effects of the various factors such as the eleven-year solar cycle, QBO, ENSO, Arctic Oscillation, stratospheric winter thermal regime and their combinations have been revealed together with their statistical significance estimations. A paper with the relevant results is in preparation. These results have been combined and processed for construction of generalized schemes for validation of the climate model SOCOL against the various observed and generalized stratospheric ozone field features.

The comparison between exact and simplified numerical schemes for the treatment of tropospheric chemistry gave satisfactory agreement. Therefore the tropospheric chemistry module based on the simplified algorithm coupling with CCM SOCOL is in progress. The parameterization of the gas transport by atmospheric convection (as function of thunder activity) and wet deposition have been completed. The paper about model sensitivity to the uncertainties in source gas surface fluxes was published in Izvestiya Russian Science Academy, Atmospheric and Oceanic Physics (No. 4, v. 43, pp. 453-462, 2007).

A 1-dimensional chemistry-transport model was used to asses the effects of Solar Proton Events (SPEs) on trace gas compounds in the mesosphere and upper stratosphere. Ionic sources of NO_x and HO_x are usually parameterized in photochemical models, but we used a direct calculation of their production after SPEs in a coupled ion and neutral chemistry routine. An optimized variant of this routine calculates changes in 29 neutral gases and 42 ions (30 positive and 12 negative). Data provided by the PMOD team (the sources of ionization from SPE) were used for model numerical experiments. Model runs revealed that the NO_x mixing ratio after a large SPE in October-November 2003 exceeded 100 ppbv in the upper mesosphere. Enhanced NO_x concentrations remain in the mesosphere during several weeks thereafter especially during polar night. HO_x perturbation is smaller and has a considerably shorter lifetime than NO_x. Nevertheless it is responsible for short-term ozone depletion (up to 50 %) in the upper mesosphere. Enhanced NO_x abundance can also lead to longer-term ozone destruction by 10-30 % in the lower mesosphere. Sensitivity studies performed with a 1-D ionic chemistry model showed the important role of the $N(^2D)$ and $N(^4S)$ partition in the act of N_2 ionic dissociation for NO_x formation. Estimates of NO_x and HO_x production rates due to one ionization event were compared with the commonly accepted parameterization. This comparison revealed good agreement for HO_x production, but NO_x production in our model is smaller than the parameterized value. An optimized version of an ionic chemistry module was included in CCM SOCOL.

The transport code of CCM SOCOL has been substantially improved. The improvements consist of: (1) including numerical descriptions of horizontal and vertical sub-scale mixing processes in the model; (2) testing new variants of the mass "fixers" procedure for mass preserving of transported species. The set of numerical experiments was performed with the improved full-interactive version of the model. Results of the experiments allowed us to choose the version of modified transport code that provided the most reasonable fields of ozone at mid and high latitudes for all years. The updated version of CCM SOCOL was used for two sets of the 10-year long time-slice model run series (for the years 2000 and 2050). Each set consists of four 10-year long model experiments series driven by SST/SI, GHG and ODS separately and all together. The model calculations are now in progress.

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Awards

The Norbert Gerbier-MUMM International Award for 2007 was presented on 28 May 2007, during the 58th session of the WMO Executive Council, to Rolf Philipona, Bruno Dürr, Atsumu Ohmura, and Christian Ruckstuhl for their paper entitled “Anthropogenic greenhouse forcing and strong water vapour feedback increase temperature in Europe”, Geophys. Res. Letters 32, L19809, 2005, doi: 10.1029/ 2005GL023624.

The Intergovernmental Panel on Climate Change (IPCC) earned the 2007 Nobel Peace Price for their scientific and technical report on climate change shared with Al Gore. The Executive Director of the United Nations Environment Programme, Achime Steiner, congratulates Dr. Rozanov for his contribution to the IPCC report, stating that he was part of the team that has earned the award.

Administration

Personnel Department

Sonja Degli Esposti

The WORCC section of WRC was augmented by Dr. Stephan Nyeki at the beginning of the year who is a specialist in the field of aerosol measurements.

PMOD/WRC now has two extra PhD students, André Fehlmann and Stefan Wacker, bringing the total to four. André Fehlmann, enrolled at the Univ. Zürich, is working on a SNF financed research project to develop a cryogenic radiometer. Stefan Wacker, enrolled at the Univ. Berne, is working on the LIRAS research project. Markus Suter, who was at the PMOD/WRC for a brief period as a civilian conscript, successfully passed his Bachelor degree in February 2007, while Marcel Sutter completed a 2-month postdoc project before leaving for a new job in Thun. Diego Wasser joined the Electronics dept. after having been at the PMOD/WRC as a civilian conscript where he spent a successful time. We are happy to have him in the team.

The number of personnel in the Administration department decreased by two members in 2007. Annika Weber took on-the-job training and successfully passed her diploma, after which she left the PMOD/WRC in June to continue her career at Buchs. Joka Sarkevic discontinued her apprentice-ship after nearly one year at the PMOD/WRC in order to pursue a different career. We wish both apprentices all the best and a successful future.

Cornelia Lindner, who was the project leader for the PMOD/WRC 100-year anniversary celebrations, was with us until December 2007. We thank Cornelia for her enthusiasm and dedication in ensuring that the anniversary celebrations were a great success.

Rolf Philipona, whose place of work has been in Payerne for the last two years, left the PMOD/WRC on 31.12.2007 and is now employed by MeteoSwiss.

Several guest scientists, apprentices and trainees also spent time at the PMOD/WRC as in previous years. Dan Smale from New Zealand, Toni Viudez i Mora from Spain, and Marco Calisto from the ETH Zürich were guest scientists at the PMOD/WRC. Fabian Weinmann was here on internship as part of his school education, and Nico Sachs worked as a trainee in the Electronics Dept. from May to August.

Last but not least: Numerous civilian conscripts had their hands full during the PMOD/WRC anniversary celebrations. Many thanks again to them all.

Scientific Personnel

Prof. Dr. Werner Schmutz	*Director, physicist, Sun-Earth connection, astrophysics, CoI ETH-Polyproject, PI PREMOS, CoI LYRA, SOVIM*
PD Dr. Rolf Philipona	*ASRB scientist, physicist (until 31.12.2007, place of work: MeteoSwiss Payerne)*
Dr. Julian Gröbner	*Department head, physicist, WRC-section IR radiometry, head UV laboratory, head WORCC, CoI PREMOS*
Dr. Eugene Rozanov	*Physicist, project manager ETH-Polyproject, Sun-Earth connection, CCM calculations, CoI LYRA, CoI PREMOS*
Dr. Wolfgang Finsterle	*Head WRC-section solar radiometry, physicist, absolute radiometry, solar physics, CoI VIRGO, SOVIM, PREMOS, LYRA*
Dr. Gregor Hülsen	*Scientist UV laboratory, physicist, COST-726 project*
Dr. Christoph Wehrli	*WORCC scientist, physicist, CoI VIRGO, SOVIM, PREMOS, LYRA*
Dr. Tatiana Egorova	*Postdoc, meteorologist, Sun-Earth connection, CCM calculations, COST-724, SNSF project*
Dr. Margit Haberreiter	*Postdoc, physicist, solar physics, CoI PREMOS, SNSF project*
Dr. Stephan Nyeki	*Scientist, WORCC-Section (since 12.2.2007)*
Marcel Sutter	*Postdoc (1.1. - 28.2.2007)*
Uwe Schlifkowitz	*PhD student, ETHZ, SNSF project*
Micha Schöll	*PhD student, ETHZ, ETH-Polyproject*
André Fehlmann	*PhD student, UNIZH, SNSF project (since 1.4.2007)*
Stefan Wacker	*PhD student, UNIBE, LIRAS project (since 1.4.2007)*
Markus Suter	*Bachelor Thesis (until 7.2.2007)*
Dan Smale	*visiting scientist from New Zealand (2.4. - 21.4.2007)*
Toni Viudez I Mora	*visiting scientist from Spain (10.9. - 30.11.2007)*
Marco Calisto	*visiting scientist, ETHZ (10.-28.9.2007)*

Expert Advisor

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

Public Relations/Media

Cornelia Lindner	*Project Manager 100 year anniversary (until 31.12.2007)*

Technical Personnel

Hansjörg Roth	*Deputy director, department head technical support, electronic engineer, experiment manager VIRGO, SOVIM, PREMOS*
Silvio Koller	*Electronic engineer, LYRA experiment manager, quality system manager*
Daniel Pfiffner	*Electronic engineer, SOVIM and PREMOS*
Marcel Spescha	*Technician*
Christian Thomann	*Technician*
Daniel Bühlmann	*Technician*
Diego Wasser	*Electronic technician (since 1.7.2007)*
Nico Sachs	*Electronic technician, temporary (21.5. - 31.8.2007)*
Jules U. Wyss	*Mechanic, general mechanics, 3D design and manufacturing of mechanical parts*
Fabian Weinmann	*internship (10. - 20.4.2007)*
Chasper Buchli	*Electronics apprentice, 3rd/4th year*
Samuel Prochazka	*Electronics apprentice, 1st/2nd year*

Administration

Sonja Degli Esposti	*Department head administration, personnel, book keeping*
Stephanie Ebert	*Secretary, part time*
Annika Weber	*Secretary, part time (until 23.6.2007)*
Joka Sarcevic	*Administration apprentice, 1st year (until 12.8.2007)*

Caretaker

Denise Dicht	*General caretaker, cleaning*
Regula Dicht, Savina Stark	*Cleaning, part time*

Civilian Service Conscripts

Florian Ruesch	*4.12.2006 - 30.6.2007*
Marcel Knupfer	*5.2. - 30.3.2007*
Gerhard Jaggi	*2.4. - 29.6.2007*
Silvio Koller	*11.6. - 6.7.2007*
Peter Stofer	*9.7. - 7.9.2007*
Romedi Selm	*30.7. - 28.9.2007*
Gabriel Schneider	*1.10.2007 - 4.2.2008*
Andrin Doll	*since 1.10.2007*

Public Seminars

6.2.2007 Markus Suter
Zürich: “Experimentelle Charakterisierung des Einflusses der Blendenerwärmung auf das Messresultat von PMO6 Absolutradiometern“

5.4.2007 Dan Smale, New Zealand: “An overview of the atmospheric research at NIWA (Lauder, NZ)”

21.6.2007 Miriam Meier,
Davos: “Das Sonnen-Analemma”

26.7.2007 Eugene Rozanov:
“Solar influence on ozone and climate during the first half of the 20th century”.

13.8.2007 Christian Monstein,
Zürich: “Callisto spectrum measurements at PMOD/WRC in Davos”

27.8.2007 Sam Krucker, UC Berkeley, USA: “Solar Flare X-ray observations: Diagnostics of Electron Acceleration”

3.12.2007 Alexander Kosovichev,
Stanford University USA: “Latest results from the HINODE mission”

Guided Tours

02.02.2007:	68	persons
12.03.2007:	30	persons
13.03.2007:	20	persons
15.05.2007:	6	persons
18.-20.6.07:	26	classes with 550 school children from Davos
18.08.2007:	40	persons
21.09.2007:	15	persons
26.09.2007:	53	persons
19.11.2007:	30	persons
30.11.2007:	21	persons

Course of Lectures, Participation in Commissions

Werner Schmutz	Course of lecture Astronomie, WS 2006/2007 and HS 2007, ETH-ZH Examination expert in astronomy, BSc ETH-ZH International Radiation Commission (IRS, IAMAS) Comité consultatif de photométrie et radiométrie (CCPR, OICM WMO) Expert Team on Meteorological Radiation and Atmospheric Composition Measurements (CIMO, WMO) International Living With a Star Working Group (ESA) Committee on Space Research, Commission of SCNAT Executive board of the Swiss Society Astronomy Astrophysics (SSAA), SCNAT) GAW-CH working group (MeteoSwiss) Swiss management committee delegate to the COST action 724 (ECF)
Wolfgang Finsterle	Expert Team on Meteorological Radiation and Atmospheric Composition Measurements (CIMO, WMO)
Claus Fröhlich	Team co-leader of CAWSES Theme 4 Membre du CPS du CNES
Julian Gröbner	Course of lecture Solar Ultraviolet Radiation WS 2006/2007 and HS 2007, ETH-ZH GAW-CH Working Group (MeteoSwiss) Swiss management committee delegate to the COST action 726 (ECF) Working group leader of COST action 726
Rolf Philipona	Course of lecture Strahlungsmessung in der Klimaforschung WS 2006/2007 and HS 2007 ETH-ZH Atmospheric Chemistry and Physics (ACP), Commission of SCNAT Working group on Surface Fluxes (WMO/WCRP/WGSF) Working group of Baseline Surface Radiation Network (WMO/WCRP)
Christoph Wehrli	Course of lecture Aerosol Optical Depth at the GAWTEC GAW-CH Working Group (MeteoSwiss) Scientific Advisory Group Aerosol (WMO/GAW)) SAG sub group AOD, chairman (WMO/GAW) Working group Baseline Surface Radiation Network (WMO/WCRP)

Donations

Various donations made possible the many activities of the anniversary year 2007. The generous donation from Mr. Daniel Karbacher (from Küsnacht, ZH) in 2005 was used on one hand in the preceding year for the preparations of the anniversary activi-ties and on the other hand for financing the events. The banks GKB and UBS acted as sponsors and the canton of Graubünden guaranteed to compensate a financial deficit. The local power company Elektrizitätswerk Davos AG has sponsored the repainting of a local bus to advertise the 100th anniversary of the PMOD and the company has covered the substantial costs of renting the advertising place on the bus for a full year.

Balance Sheet 2007

Aktiven	31.12.2007 CHF	31.12.2006 CHF
Kassa	2'121.60	1'291.20
Postchek	9'325.29	113'821.19
Bankkonten	621'891.29	673'737.71
Debitoren	44'385.30	115'435.75
Verrechnungssteuer	2'152.50	742.55
Mehrwertsteuer	30'389.45	39'315.57
Kontokorrent Drittmittel	489'784.41	541'072.62
Abgrenzung VSt.	2'226.00	
Transitorische Aktiven	31'738.00	4'151.00
	1'234'013.84	1'489'567.59

Passiven	CHF	CHF
Kreditoren	161'940.09	124'680.61
Abgrenzung Umsatzsteuer	182.35	
Kontokorrent Stiftung	-24'206.90	88'618.80
Transitorische Passiven	434'375.00	557'940.55
Rückstellungen 100 Jahre Obs/IPC-XI/UVC	111'334.90	104'551.35
Rückstellungen	401'205.95	461'338.45
Eigenkapital	149'182.45	152'437.83
	1'234'013.84	1'489'567.59

Annual Accounts 2007

Ertrag	CHF
Beitrag Bund Betrieb WRC, IRC	1'108'984.00
Beitrag Bund Betrieb WORCC	280'000.00
Beitrag Kanton Graubünden	173'285.00
Beitrag Landschaft Davos	259'927.50
Beitrag Landschaft Davos, Mieterlass	145'675.00
Beitrag Landschaft Davos, Ersatz Stiftungstaxe	150'000.00
Beitrag MeteoSchweiz, Kyoto Beitrag	75'000.00
Forschungsbeitrag SFI, ASRB	90'000.00
Forschungsbeitrag EUSAAR	29'985.00
Einnahmen Drittmittel	1'059'632.33
Instrumentenverkauf	238'213.40
Diverse Einnahmen/Eichungen	83'882.60
Spenden 100 Jahre PMOD	70'000.00
Wertschriftenertrag/Aktivzinsen	8'832.27
	3'773'417.10

Aufwand	CHF
Gehälter	1'686'510.80
Sozialleistungen	283'947.50
Ausgaben Drittmittel	1'059'632.33
Investitionen	125'095.52
Unterhalt	20'677.10
Verbrauchsmaterial	44'778.92
Verbrauch Commercial	37'642.29
Reisen, Kongresse, Kurse	84'641.85
Bibliothek und Literatur	13'916.66
Raumkosten	145'675.00
100-Jahr Feier	104'536.90
Verwaltungskosten	169'617.61
	3'776'672.48
Ergebnis 2007	-3'255.38
	3'773'417.10

Abbreviations

AOD	*Aerosol Optical Depth*
ACRIM	*Active Cavity Radiometer for Irradiance Monitoring*
AGU	*American Geophysical Union*
ARM	*Atmospheric Radiation Measurement*
ASRB	*Alpine Surface Radiation Budget*
ATLAS	*Shuttle Mission with solar irradiance measurements*
BESSY	*Berliner Elektronen Speicher Synchrotron*
BOLD	*Blind to optical light detector*
BSRN	*Baseline Surface Radiation Network of the WCRP*
BUSOC	*Belgian User Support and Operation Centre of ESA*
BUWAL	*Bundesamt für Umwelt, Wald und Landschaft, Bern*
CART	*Cloud and Radiation Testbed*
CCM	*Chemistry-Climate Model*
CAS	*Commission for Atmospheric Sciences, commission of WMO*
CIE	*Commission Internationale de l'Eclairage*
CIMO	*Commission for Instruments and Methods of Observation of WMO, Geneva*
CMDL	*Climate Monitoring and Diagnostic Laboratory*
CNES	*Centre National d'Etudes Spatiales, Paris, F*
CNRS	*Centre National de la Recherche Scientifique, Service d`Aéronomie Paris*
CoI	*Co-Investigator of an Experiment/Instrument/Project*
COSPAR	*Commission of Space Application and Research of ICSU, Paris, F*
COST	*Co-operation in the field of Scientific and Technical Research, an intergovernmental framework program of the ESF*
CPD	*Course Pointing Device*
CTM	*Chemical Transport Model*
CUCF	*Central UV Calibration Facility, NOAA, Boulder, USA*
DIARAD	*Dual Irradiance Absolute Radiometer of IRMB*
DLR	*Deutsche Luft und Raumfahrt*
EGS	*European Geophysical Society*
EGSE	*Electrical Ground Support Equipment*
ERBS	*Earth Radiation Budget Satellite*
ESA	*European Space Agency, Paris, F*
ESF	*European Science Foundation*
ESOC	*European Space Operations and Control Center, Darmstadt, D*
ESTEC	*European Space Research and Technology Center, Noordwijk, NL*
ETH	*Eidgenössische Technische Hochschule*
EURECA	*European Retrievable Carrier, flown August 1992 - June 1993 with SOVA experiment of PMOD/WRC*
EUSAAR	*FP6 project: European Supersites for Atmospheric Aerosol Research*
EUV	*Extreme Ultraviolet Radiation*
GAW	*Global Atmosphere Watch, an observational program of WMO*
GAWTEX	*GAW Training & Education Center*
GCM	*General Circulation Model*
GEWEX	*Global Energy and Water Cycle Experiment of WCRP*
GHG	*Greenhouse Gases*
GOLF	*Global Oscillations at Low Frequencies= experiment on SOHO*
GONG	*Global Oscillations Network Group*
GSFC	*Goddard Space Flight Center, Maryland, USA*
HALOE	*Halogen Occultation Experiment on board UARS*
HF	*Hickey-Frieden Radiometer manufactured by Eppley, Newport, USA*
IACETH	*Institute for Climate Research of the ETH-ZH*
IAMAS	*International Association of Meteorology and Atmospheric Sciences of IUGG*
IAU	*International Astronomical Union of ICSU, Paris, F*
IFU	*Institut für Umweltwissenschaften, Garmisch-Partenkirchen*
ICSU	*International Council of Scientific Unions, Paris, F*
INTA	*Instituto Nacional de T´ecnica Aerospacial, Estaci´on de Sondeos Atmosf´ericos El Arenosillo*
INTAS	*International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union, EU grant*
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, IAMAS*
ISS	*International Space Station*
IUGG	*International Union of Geodesy and Geophysics of ISCU*
JPL	*Jet Propulsion Laboratory, Pasadena, California, USA*
JRC	*Joint Research Center of the European Commission in Ispra, Italy*
KIS	*Kiepenheuer-Institut für Sonnenphysik, Freiburg i.Br.*
LAP	*Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki*
LOI	*Luminosity Oscillation Imager, Instrument in VIRGO*
LYRA	*Lyman-alpha Radiometer, experiment on PROBA 2*
MCH	*MeteoSwiss, Zürich*
METAS	*Swiss Federal Office of Metrology and Accreditation*
MODTRAN	*Moderate Resolution Transmission Code (in Fortran)*
NASA	*National Aeronautics and Space Administration, Washington, USA*
NCEP	*National Center for Environmental Prediction, NOAA, USA*
NIMBUS7	*NOAA Research Satellite, launched Nov.78*
NIP	*Normal Incidence Pyrheliometer*
NMC	*National Meteorological Center, USA*
NOAA	*National Oceanographic and Atmospheric Administration, USA*
NPL	*National Physical Laboratory, Teddington, UK*
NRL	*Naval Research Laboratory, Washington, USA*
NREL	*National Renewable Energy Lab*
NRPA	*Norwegian Radiation Protection Authority*
ODS	*Ozone Destroying Substances*
PDR	*Preliminary Design Review*
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*
PIR	*Precision Infrared Pyrgeometer von Eppley*
PMOD	*Physikalisch Meteorologisches Observatorium Davos*
PMO6-V	*VIRGO PMO6 type radiometer*
PREMOS	*Precision Monitoring of Solar Variability, PMOD/WRC experiment on PICARD,to be launched 2009*
PROBA 2	*ESA technology demonstration space mission*
PRODEX	*Program for the Development of Experiments der ESA*
PTB	*Physikalisch-Technische Bundesanstalt, Braunschweig & Berlin, D*
QASUME	*Quality Assurance of Spectral Ultraviolet Measurements in Europe*
RA	*Regional Association of WMO*
ROB	*Royal Belgian Observatory*
SAG	*Scientific Advisory Group of the GAW program*
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*
SNSF	*Swiss National Science Foundation*
SOCOL	*Combined GCM and CTM computer model, developed at PMOD/WRC*
SOHO	*Solar and Heliospheric Observatory, Space Mission of ESA/NASA*
SOL-ACES	*Solar Auto Calibrating EUV/UV Spectrometer for the Internatio-nal Space Station Alpha by IPM, Freiburg i.Br., Germany*
SOVA	*Solar Variability Experiment on EURECA*
SOVIM	*Solar Variability and Irradiance Monitoring, PMOD/WRC experiment for the International Space Station Alpha, since 2008*
SPC	*Science Programme Committee, ESA*
SPM	*Sun photometer*
SST/SI	*Sea Surface Temperature and Sea Ice*
STEP	*Solar Terrestrial Energy Program of SCOSTEP/ICSU*
STUK	*Radiation and Nuclear Safety Authority, Non-Ionizing Radiation Laboratory, Helsinki*
SUSIM	*Solar Ultraviolet Spectral Irradiance Monitor on board UARS*
TSI	*Total Solar Irradiance*
UARS	*Upper Atmosphere Research Satellite of NASA*
UIIMP	*Innsbruck Medical University, Division for Biomedical Physics*
UV	*Ultraviolet radiation*
VIRGO	*Variability of solar Irradiance and Gravity Oscillations, PMOD/WRC experiment on SOHO, launched December 1995*
WCRP	*World Climate Research Program*
WDCA	*World Data Center for Aerosols, Ispra*
WISG	*World Infrared Standard Group of pyrgeometer, maintained by WRC*
WMO	*World Meteorological Organization, a United Nations Specialized Agency, Geneva*
WORCC	*World Optical Depth Research and Calibration Center, WRC section*
WRC	*World Radiation Center, Davos*
WRDC	*World Radiation Data Center, St. Petersburg*
WRR	*World Radiometric Reference*
WSG	*World Standard Group, realizing the WRR, maintained by WRC*
WWW	*World Weather Watch, an observational program of WMO*

On February 7, 2008, the space shuttle *Atlantis* was launched to the International Space Station (ISS). It brought the European module *Columbus* to the ISS where part of the payload was two platforms to be externally mounted on *Columbus*: One looking downwards, the other upwards. This photo of the open cargo bay was taken on February 8, 2008. The *Columbus* module is in the rear of the bay and the two external payloads are in the front. The payload on the left is the European Technology Exposure Facility (EuTEF), and the payload on the right is the *SOLAR* platform which comprises three experiments on a tracker to observe the Sun. *SOVIM* is the right-most of these three experiments which was built by PMOD/WRC. (© ESA)

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