SESSION 3

TROPICAL AND SUBTROPICAL OBSERVATIONS AND ANALYSES

Oral Session

3-1 The atmospheric observatory of Reunion Island and the Maïdo facility

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Reunion Island Atmospheric Physics Observatory (OPAR) is a scientific structure involving several partners: CNRS, Reunion Island University, and Reunion Island Council. In the present situation of global climatic changes, the survey of atmospheric and climatic key parameters is more and more relevant. The observation and understanding of climate changes should indeed be based on analysis of long-term trends of those parameters. It is then very important to follow the evolution of large-scale transport mechanisms and of the chemical composition of the atmosphere, especially in the southern hemisphere, where very few instrumental facilities are available. Measurements performed by OPAR are embedded in this scientific context. This structure officially created in February 2003 is dealing with all atmospheric measurements at Reunion Island. This geographical situation, quite unique in the southern hemisphere, enables observation of physical phenomena that concern a large part of the Indian Ocean area. Indeed, due to its location, Reunion Island is seasonally submitted to biomass burning plumes transported from the subcontinent of Southern Africa, which can significantly affect the free troposphere concentrations of CO2, ozone, CO and atmospheric aerosols. Moreover, it is affected by the dynamical influence of the subtropical jet stream and by the tropical convection. Concerning the stratosphere, the island is located near the subtropical barrier and special patterns of stratospheric ozone transport can be observed. The instrumental setup at Reunion Island started to be installed at the beginning of the nineties, with PTU and ozone soundings, SAOZ spectrometer and Stratospheric Rayleigh Lidar measurements. Due to the increasing interest in atmospheric measurements at this latitude, some other systems (tropospheric and stratospheric ozone lidars, photometers, spectrometers, Doppler Lidar, FTIR...) have been implemented since 2000. OPAR is part of the NDACC network and is involved in others atmospheric observation networks such as SHADOZ, and AERONET. Until now, all the instruments have been installed at Saint Denis de la Reunion, on a campus a few meters above sea level and within the atmospheric boundary layer, which is not optimum for optical measurement such as Raman Lidar with very low signal to noise ratios. In order to increase the number and diversity of observations of atmospheric dynamical and chemical parameters

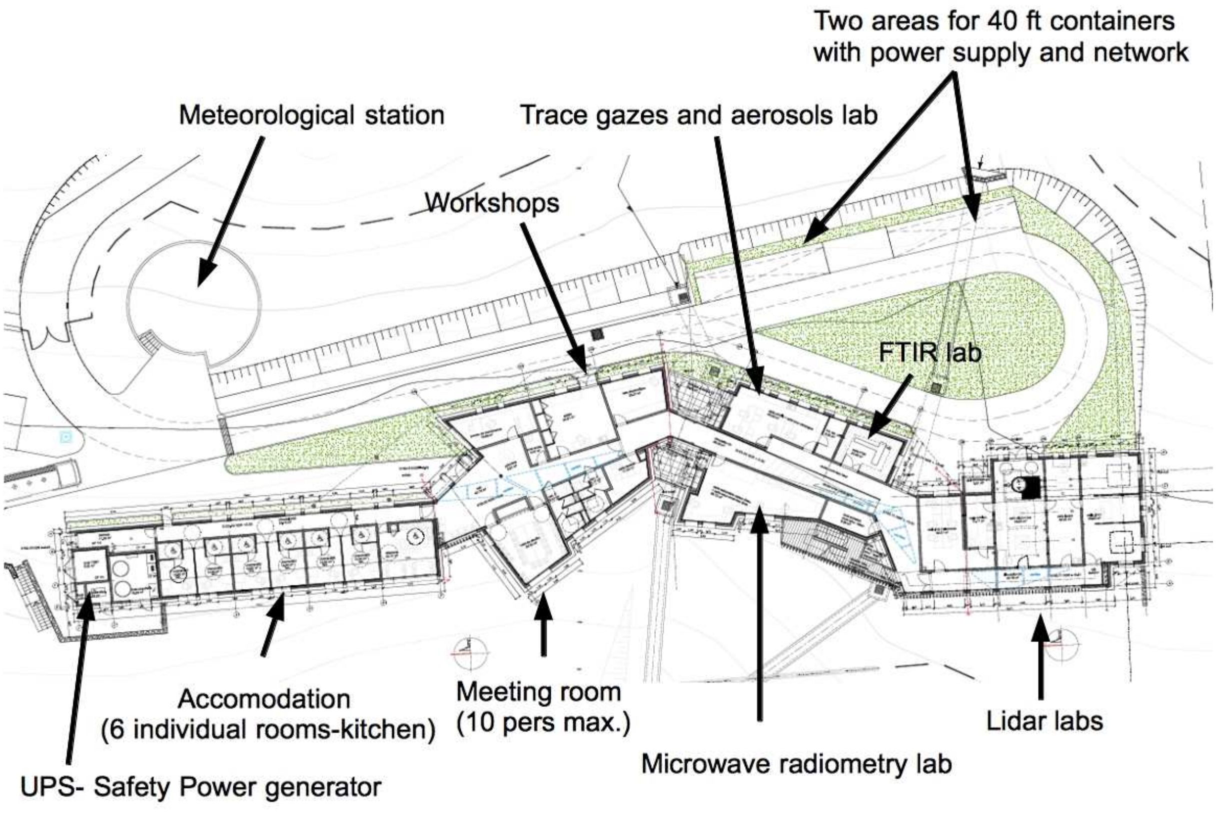
started in the nineties, a new facility is currently being built at the top of the Maïdo Mountain at 2200 m altitude, on the western part of Reunion Island. It will become the main instrumented facility of OPAR.

> This facility, called Maïdo station, is supported by Reunion Island Council and European Community for building funding and by CNRS for instruments. By the end of year 2011, most optical instruments installed on the Reunion University Campus at Saint Denis de la Reunion, will move to this new facility, in a building with a 700 square-meters useful area. The aim of the facility is mainly to increase the quality of optical measurements and to enable free troposphere in situ sampling, mainly by night air subsidence. All the five lidar systems (Rayleigh-Mie, Raman, Stratospheric ozone, Tropospheric ozone and Wind Doppler), and some other optical, microwave and chemical sensors should be installed in this new facility in order to increase their performances far away from populated areas. This station will be located in the Reunion Island National Park and will enable to receive instrumented shelters from international partners to perform specific measurement campaigns. One goal is also to become a global station of the GAW program (Global Atmospheric Watch, WMO), since due to its altitude the Maïdo station allows sampling in the free troposphere during nighttime subsidence periods and/or GRUAN (GCOS Research Upper Air Network) due to the various remote sensing techniques available.

Instrument		Network/ Date of operation	Measurements - range
Lidars	Stratospheric Ozone DIAL	NDACC (2000)	Stratospheric O3 (15-45 km)
	Rayleigh-Mie-Raman	NDACC	Temperature, (15-80 km), stratospheric aerosols (15 - 50 km), Cirrus
	Tropospheric Ozone DIAL	NDACC Candidate (2000)	Tropospheric O3 (3-15 km)
	Tropospheric	NDACC Candidate (2000)	Tropospheric H2O (3-15 km)
	Wind Doppler	(2010)	Horizontal wind (5-50 km)
Mobile Lidar System		(2008)	Aerosols, cirrus (0,15-12 km)
Radiosounding		NDACC, SHADOZ (1992)	Temperature, Humidity, O3, wind (0 – 35 km)
Spectrometers	SAOZ	NDACC (1992)	O3, NO2 Total columns
	FTIR	NDACC (2009)	CO, O3, NO, OCS, HF, HCl, HNO3, HCHO, 0-50 –km
	FTIR (near IR)	GAW Candidate 2010	CO2 Total columns
	UV	NDACC candidate 2010	UV spectrum 200-400 nm (0.5 nm resolution
Radiometers Photometers	Microwave 22 Ghz, H2O	2011, NDACC candidate	Stratospheric H2O (20 - 60 km)
	Cimel CE 318	AERONET	Aerosol optical depth
	Cimel CE 312		Clouds, Cirrus
UHF Radar		C-WINDE	3D wind, turbulence, precipitation
In situ measurements	Ozone UV abs.	GAW Candidate 2010	O3 (ground level)
	GES (CRDS-Diode laser)	GAW Candidate 2010	CO2, CH4, H2O (ground level)
	Carbon monoxide (IR Correlation)	GAW Candidate 2011	CO (ground level)

Instruments operated at the atmospheric observatory of Reunion Island

Numerical Synthesis view of the future Maïdo station in 2012



Distribution of various facilities inside and around the Maïdo building

Oral Session

3-2 A SHADOZ Ozone Climatology in the Aura Era: Tropospheric and Lower Stratospheric Profiles with Total Ozone Comparisons to OMI

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A regional climatology of SHADOZ ozone profiles in the troposphere and lower stratosphere is presented that is based on measurements taken during the Aura era, 2005-2009, when several new stations joined the network (Hanoi, Hilo, Hawaii; Alajuela/Heredia, Costa Rica; Cotonou, Benin). Fifteen stations operated during that time. A west-to-east progression of decreasing convective influence and increasing pollution distinguishes tropospheric ozone observed in three regions: western Pacific/eastern Indian Ocean; equatorial Americas (San Cristóbal, Alajuela, Paramaribo); the Atlantic and Africa. As such, each station has unique value for evaluating satellite algorithms and model simulations of ozone. Possible station biases in the stratospheric segment of the ozone measurement and noted in the first 7 years of SHADOZ ozone profiles (Thompson et al., 2003; 2007; cf Smit et al., 2007) are re-examined. Comparisons in total ozone column from soundings, the OMI satellite and ground-based instrumentation are presented.

Oral Session

3-3 Tropopause characteristics and variability from 11-year SHADOZ observations in the southern tropics and sub-tropics

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Here, We present the tropopause characteristics observed from tropical to subtropical southern hemisphere stations [San-Cristobal : 0.92°S, 89.60 °W, Nairobi : 1.27°S, 36.8°E, Natal : 5.42°S, 35.38°W, Watukosek–Java : 7.57°S, 112.65°E, Ascension : 7.98°S, 14.42°W, Am. Samoa : 14.23°S,170.56°W, Fiji : 18.13°S, 178.40°E, La Réunion : 21.06°S, 55.48°E and Irene : 25.9°S, 28.22°E] using Southern Hemisphere Additional Ozonesonde (SHADOZ) data for the 11-year period, 1998 to 2008. Three different definitions of tropopause, Cold Point Tropopause (CPT), Lapse Rate Tropopause (LRT) and Ozone Tropopause (OT), are determined and their variability for nine different SHADOZ sites is studied for the purpose of evaluating their usefulness as indicators of possible tropopause trends. For each station, the OT is uniquely defined by ozone gradient and is found to be more variable than either the LRT or CPT. The OT roughly coincides with the upper boundary of the region of most active convective mixing over the western Pacific and with the lower boundary of the transition region from troposphere to lower stratosphere that is generally referred to as the tropical tropopause layer (TTL). The monthly and year-to-year variations of tropopause are examined and the annual cycle in OT, the dominant signal, is described. The distance of separation of OT between CPT or LRT is smaller for the tropics (stations at 0º-15ºS) than the sub-tropics (15ºS-25ºS). The decadal trend in tropopause heights is measured using a statistical model that accounts for natural variations expressed in the El Nino-Southern Oscillation (ENSO), Quasi-biennial Oscillation (QBO) and Indian Ocean Dipole (IOD). The decadal trend estimation shows no statistically significant trend for CPT and LRT in the tropics, in contrast to other studies, however, a decrease in altitude for OT is significant. In the subtropics the CPT and LRT decline significantly, -240 m/decade and -190 m/decade, respectively but the OT shows an increasing trend of 160 m/decade.

Oral Session

3-4 Tropospheric Ozone Observations and analysis in the South-west of Indian Ocean (Reunion and Kerguelen Islands).

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We present long series observations of tropospheric ozone performed at Reunion and Kerguelen Island. For Reunion sites, measurements have been perform respectively since 1992 with radiosondes and since 1998 with DIAL lidar. An annual cycle is observed with a maximum of tropospheric ozone in austral spring (September-October-November). This maximum coincide with the biomass burning season of the southern hemisphere. Using Potential Vorticity calculated with ECMWF reanalysis, FLEXPART trajectory and Reverse Domain Filling LACYTRAJ calculations, we show that it coincide also with a maximum of occurrence of stratospheric intrusion into the troposphere. The Reunion dataset is long enough to determine climatological and long term trend characteristics for this site, in regards to the evolution of biomass burning and stratosphere to troposphere exchange induced by the subtropical jet stream and tropical convection. Considering the whole tropospheric column, a slightly positive trend is observed on the deseasonnalised dataset from 1992 to 2011 (+1.71 +/- 0.55 DU per decade). The separation of the troposphere into three layers and seasons shows that the strongest trends are observed in the upper troposphere, and in austral winter and spring seasons. The Kerguelen dataset is a 17 radiosondes campaign performed in 2008 and 2009. The analysis of the Kerguelen dataset demonstrates that it is also affected by long range transport of biomass burning. The GIRAFE (reGIonal ReAl time Fire plumEs) - FLEXPART model shows that the higher values of ozone in austral winter than in austral summer correspond to signatures of biomass burning plumes emitted from southern Africa and South America, and transported by the westerly circulation of southern hemisphere. A case of polar stratosphere to troposphere event is documented. The analysis based on ECMWF ERA-Interim global model reanalysis and trajectory and Reverse Domain Filling calculations evidenced the influence of a stratospheric filament into the troposphere induced by a curvature of the polar jet stream, mixed with a tropospheric subtropical air mass. FLEXPART forward simulations indicate that the major part of the particles remains in the troposphere the days following the stratospheric intrusion. In terms of perspective, concerning the Reunion site, it is important to continue the long serie of ozone measurements to document other case studies and survey the long term trends. Another campaign at Kerguelen Island could allow to explicit the annual cycle of ozone for this site. In addition, our objective is to develop water vapor Raman lidar measurement at the Maïdo station. The new system could allow to cover the UTLS and this additional tracer could be very useful for stratosphere-troposphere exchange studies.

Oral Session

3-5 The African tropical belt: widening and positive trends of ozone as seen by MOZAIC routine in-situ airborne measurements.

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Recent studies suggest that an unequivocal sign of climate change in the tropics is the widening of the tropical belt (e.g., Hu et al., 2007 ; Seidel et al. 2008). Important potential implications include changes in the tropical and subtropical regional climates (e.g., shifts in precipitation patterns) and changes in the transport of trace gases from the tropical troposphere to the stratosphere. This work tackles the topic by analysing in-situ data from the airborne programme MOZAIC (Measurements of Ozone, Water Vapour, Nitrogen Oxides and Carbon Monoxide by Airbus In-service Aircraft, http://mozaic.aero.obs-mip.fr). From 1995 to 2009, longhaul MOZAIC-equipped aircraft have regularly sampled the African tropical upper troposphere, building an exceptional in-situ dataset for meteorological parameters and for atmospheric composition. First, climatologies for meteorological parameters, as well as for ozone and for carbon monoxide are analysed. Characteristics signatures of the distribution of trace gases embedded in upper tropospheric large scale circulations are analysed and shown to evolve seasonally. Then, a series of metrics for assessing the width of the tropical belt is defined with thermo-dynamical parameters. A statistically robust expansion of the tropical belt is shown to take place, mainly on its southern side. Trends are compared to values published so far in the literature. Finally, seasonal variations and positive trends of upper tropospheric ozone concentrations within the tropical belt are analysed and discussed. The bunch of results presented here confirms that important and statistically robust changes are taking place in the African tropical belt. References: Hu, Y., and Fu, Q. Observed poleward expansion of the Hadley circulation since 1979. Atmos. Chem. Phys. 7, 5229–5236 (2007). Seidel D. J., Fu Q., Randel W.J., Reichler T.J., Widening of the tropical belt in a changing climate, Nature Geoscience, 1, 21-24, 2008.

3P-1 Classification of Ozonesonde Profiles from the SHADOZ Stations at Ascension and Natal using Self-Organizing Maps

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Ozone profiles from balloon-borne ozonesondes are used for development of satellite algorithms and in chemistry-climate model initialization, assimilation and evaluation. An important issue in the application of these profiles is how best to treat variations where varying photochemical and dynamical influences can cause the ozone mixing ratio in the tropospheric segment of the profile to change by of a factor of 2-3 within a day. Clustering techniques are one way to approach the statistical classification of profile data and we apply self-organizing maps (SOMs) to tropical tropospheric SHADOZ data, hypothesizing that the data will sort according to various influences on ozone, eg anthropogenic sources like biomass burning, meteorological conditions and intrusions of extra-tropical air. SOMs have been determined for the 1998-2009 SHADOZ profiles over Ascension Island (7.98S, 14.4W) and Natal, Brazil (5.42S, 35W), in a progression of clusters sets with 2x2 to 4x4 specifications. The 2x2 SOM over Ascension, which creates 4 clusters, reveals that deviations from a standard ozone average in the free troposphere include increased ozone resulting from seasonal African biomass burning and locally reduced ozone brought about by convective lifting of unpolluted boundary layer air. Expanding to a 4x4 SOM shows how biomass burning influences tropospheric ozone at Ascension Island at finer time-scales and captures the seasonality of ozone at Natal as well. Comparing Ascension Island and Natal using a 4x4 SOM at each site reveals similarities in mid-tropospheric ozone, but shows differences in lower tropospheric ozone due to Ascension Island being closer to African fires, as well as more affected by descent from the mean Walker circulation and with less convective activity, than Natal.

3P-2 Ozonesonde measurements at La Reunion Island NDACC-SHADOZ station : 21.0°S 55.5°E 8masl Measurement period 19 92 to 2011

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The aim of this presentation is to report on 18 years of ozonesonde measurements performed at La Reunion Island (21°S, 55.5°E) located in the Sou thwestern Indian Ocean. In 1998, La Reunion site joined the SHADOZ program (Southern Hemisphere Additional OZonesondes) allowing to improve the frequency of measurements to one a week. First a description of the instrumentation is provided with focus on the change from Vaisala RS80 to Modem M2K2 meteorological radiosonde. Then a comparison is made between the total ozone column values measured by ozonesondes and those given by satellite (AURA/OMI spectrometer) and the ground based SAOZ UV-spectrometer implemented at La Reunion. Processes influencing ozone concentration over La Reunion are also identified: stratospheric-tropospheric exchanges and biomass burning activity in the troposphere, air masses transport (enriched or poorer in ozone) from remote regions in the stratosphere.

3P-3 Watukosek Tropospheric Ozone Characteristics Based on Long-term Data Observation and Its Comparison to the OMI Satellite Data.

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The standard profiles of tropospheric ozone and vertical temperature at Watukosek ozone observation site, East Java, Indonesia have been established based on the long-term observation of ozonesonde within the time span observation of 1993-2003. In situ data of Watukosek tropospheric ozone and vertical temperature in the period of 2004 to 2010 from SHADOZ network were used to verify the established Watukosek standard profile by comparing each monthly profile of ozone and temperature and also calculating the deviation and each correlation factor. In addition, the 2004-2010 period of in-situ ozone and temperature data are also be used to investigate the ozone mixing ratio and temperature changes at Watukosek in that period. Tropospheric ozone for Watukosek from OMI satellite also has been analyzed in term of trend and seasonal variation characteristics. Watukosek tropospheric ozone mixing ratio shows an annual seasonal behavior with a minimum value during March (36 ppbv) and a maximum value during November (50 ppbv). Average of ozone mixing ratio in Watukosek is 41 ppbv. Continue monitoring of Watukosek vertical ozone profiles under the SHADOZ network program is the future plan to establish Watukosek ozone climatology and as contribution to the world ozone data base. Brewer spectrophotometer MK-IV (#94) was operated at Watukosek from 1994 to 2000. This activity is coordinated by NASDA to support her ADEOS satellite. Due to the technical problem, after 2000 this observation is stopped. On the other hand, in 1996 LAPAN also installed Brewer spectrophotometer MK-IV (#116) in Bandung, which is in operation until 1998. In 2006 those instruments are reactivated by the technical assistance of WMO. Brewer data of Bandung in the period of 2006-2008 will be presented here. Research concerning the impact of higher UV-B radiation and relatively thin of the ozone layer in Indonesia are also needed as a consequence of the country which is located in the equatorial region and received UV radiation throughout year. Therefore, measurement of solar UV radiation in Indonesia (in this case measurement of UV index) is extremely needed. In Indonesia region, as shown in time series of UV Index derived from OMI_AURA data in the time span of 2004-2010, UV index levels are normally extreme. Range of UV Index in Indonesia region usually existed between 8 and 15. The preliminary result of in-situ measurement of UV Index in Indonesia (first observation site located in Bandung, West Java) in the period of 2007 to 2010 would also be investigated. The planning of additional site of UV measurement in the coming year is under investigation.

3P-4 Tropical waves in the South West Indian Basin during TC season 2008

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Tropical waves play an important role in the dynamics of the lower and upper atmosphere in the tropics. Their impacts on the general circulation are now widely recognized. Because of the variability of scales in time and space and scale interaction, continuous and intensive observation with high accuracy and resolution are still needed to improve our understanding on tropical waves and modeling/forecasting. The present study provides a snapshot of tropical waves observed during tropical cyclone (TC) season 2007-2008 in the South-West Indian Basin [40-70°E, 0-30°S]. TC season 2007-2008 was special with 17 tropical storms, 9 TCs and 4 intense TCs. Radiosonde datasets at Mahé (4.66°S, 55.53°E), Antanarivo (18. 8°S, 47.48°E) and Gillot (20.9°S, 55.53°E) and GPS COSMIC are fully analyzed to derive the characteristics of waves as well as their time and space distribution. Relationships with convective activity such TCs are also investigated.

3P-5 Characteristic of gravity waves generated by the intense tropical cyclone Ivan (2008) in the UT/LS : observations and numerical study

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Tropical cyclones (TC) are the most severe meteorological phenomena in the tropical South-West Indian ocean (SWIO ; 30-90°E ; 0-40°S). Tropical cy clone activity in this basin represents 10-12% of the global activity. A good knowledge of the multiscale wave processes involved in the dynamics of TCs, is important to improve tropical cyclone numerical modeling and forecasting as well as to understand their impact as convective sources of gravity waves (GW) on the atmosphere. Recently, Ibrahim et al.(2010) analyzed the GW energy density in the vicinity of Tromelin Island, to suggest GW energy density in the Low Stratosphere as an index of diagnosis TC activity. In this study, observations and high-resolution simulations are used to characterize the GWs generated by a TC (period, wavelength, energy density) and to study the impact of these GWs on the TC structure , and environment. On February, 5th, the future “Ivan” system is located west of the Agalega island. On February, 7th, the system becomes a moderate tropical storm. The system is then called Ivan and continues to intensify until the night of 7 February, when it becomes a strong tropical storm. Then the system is quasi stationary for more than 24 hours. In the afternoon of February, 13th more favorable conditions permits the formation of a closed eye and the passage to tropical storm on the morning of 14 February. On February, 15th the system is classified as TC. It intensifies again to the stage of intense TC during the morning of February 16. The system lands at 0400 UTC on February, 17th on the southern region of Sainte Marie island with maximum winds of 230km/h. Then Ivan reaches the Madagascar coast shortly after 0600 UTC, with an intensity of 935 hPa and winds around 95 knots. Then the system crosses the Madagascar island and begins its extratropical transition. It dissipates during the day of February 22. On the one hand, the characteristics of the GWs generated by TC Ivan are analyzed using the GPS COSMIC RO over the SWIO, and the GPS winsonde data at the meteorological stations of Gillot, Réunion (21°S ; 55°E) and Tananarive, Madag ascar (19°S ; 47°S). During the period of activity of TC Ivan (5 February to 22 February), temperature and wind profiles from the Gillot and Tananarive soudings are used to computed the characteristics of GW in the upper troposphere and in the lower stratopshere. On the other hand, the TC Ivan is simulated with the Meso-NH model. The model is configured for only one domain. It contains 360x600 points with 4-km grid spacing. The domain has 55 vertical levels in a stretched grid with higher resolution in the boundary layer and in the UT/LS. The initial and lateral boundary conditions of the meteorology are obtained from Aladin-Reunion. The Simualion begins the 14 February at 00h UTC and ends the 18 February at 18h UTC, this period corresponds to the phase intensification and landfall of the system. The simulation results is correct, by comparison with Best Track (Météo-france) data, the simulated Track and the temporal intensity evolution are well reproduced. Finally the characteristic of the GW generated by the modeled TC Ivan will be computed with the same method as in the first part, and will be compared to observations.

3P-6 An Antarctic polar filament observed by GOMOS/ENVISAT during spring 2004: isentropic transport over a southern subtropical station, Irene (South Africa).

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Abstract

In this paper, the first isentropic transport event investigated by the stellar occultation instrument GOMOS is presented. Our study exhibits two interesting results, primarily, the ability of GOMOS to capture and to reproduce ozone structures in the subtropics due to his good vertical resolution (Bertaux et al., 2010). Secondarily, the isentropic transport process which occurs during ozone depletion in the 2004 Antarctic polar vortex reaching the subtropics and results to an ozone enhanced layer. Indeed, on 13 October 2004, a GOMOS occultation measured in the vicinity of a polar filament exhibits an ozone enhanced layer in the lower stratosphere near Irene (25.90°S; 28.22°E). Furthermore, the high resolution advection model MIMOSA (Hauchecorne et al., 2002) highlights this transport process and reproduce this filament. During ozone depletion, a filament is drawn out from the Antarctic polar vortex, developed and moved toward the subtropics on 430 K and 450 K. Finally, we suggest that the filament of ozone-rich air observed over Irene originates from the vortex edge region rather than the vortex core (Manney et al., 1994; Mariotti et al., 2000).

Figures

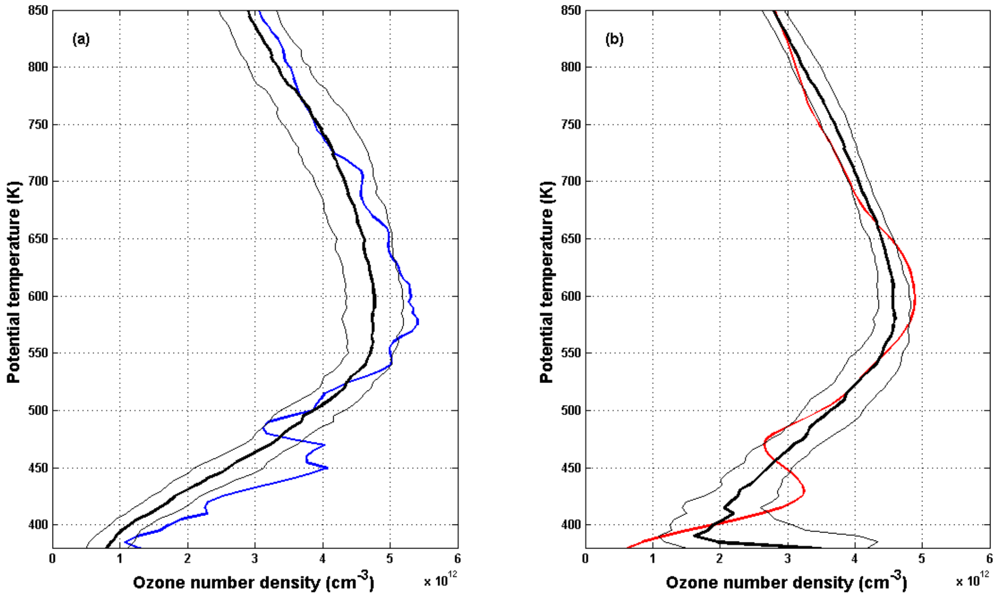

Figure 1 : (a) Ozone profile number density as obtained from ozonesonde launches at 10:20 UT over Irene (25.90°S; 28.22°E) on 13 October 2004 (blue line). The climatological profile (mean profile) is superimposed (thick line). The thin continuous lines indicate the ±1σ.   Ozone profile from GOMOS dark occultation measured on the same day at 22:09 UT (red line) near the filament (26.28°S; 32.34°E). The climatological profile (median profile) is superimposed (thick line). The thin continuous lines refer to the 25th and 75th percentiles for the median profile.

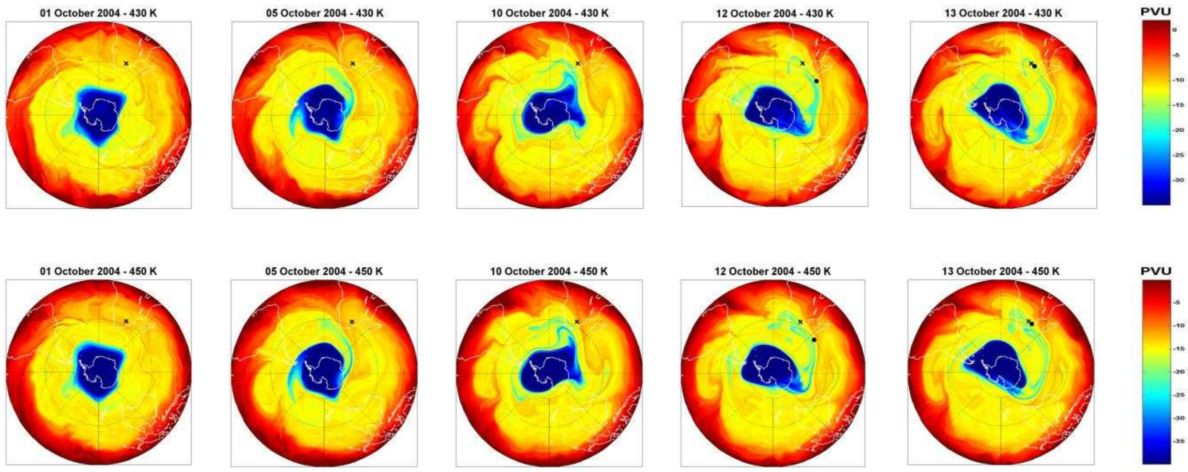

Figure 2 : Polar stereographic projections maps of Advected Potential Vorticity (APV) onto the 430 K and 475 K isentropic surfaces computed from the high resolution model MIMOSA at 12:00 UT. Outputs are represented for 1, 5, 10, 12 and 13 October 2004. The black cross represents Irene station and the GOMOS occultation locations are also superimposed (black dots). PV is in units 10^{-6} K.m^{2}.kg^{-1}.s^{-1}.

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3P-7 Raman Lidar and Sodar measurements in the State of Sao Paulo, Brazil

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Systematic observations with a single channel elastic backscatter Lidar (532 nm) have been carried out at the Centro de Lasers e Aplicações in Metropolitan São Paulo (23o 33'S, 46o 44'W) since 2001, but in 2009, a Raman channel was added. Besides aerosol property studies, the laboratory also carries out Planetary Boundary Layer (PBL) measurements and cirrus observations.

The drastically increased production of ethanol from sugar cane in several regions of Brazil, especially in the central and western parts of the State of São Paulo, created wide-ranging environmental problems, due to the mostly nocturnal practice of burning the sugar cane fields prior to manual harvesting, resulting in vast emissions of biomass-burning products, such as aerosols and various greenhouse gasses. With this in mind, the Brazilian state-owned Oil Producer and Refinery Owner, Petrobras, approved an Infrastructure Project in 2008 (Landulfo et al., 2010; SPIE Proceedings), through which a mobile Lidar with Raman channel and a medium-sized Sodar were acquired in 2009.

The mobile bi-axial Lidar system uses a pulsed Nd:YAG laser, operating at a wavelength of 532 nm, and yields a spatial resolution of 7,5 m up to about 20 km. The Sodar monitors the vertical distribution of wind (u, v, w) within the lower PBL up to 500–800 m above ground level (AGL). Average vertical profiles with 10 m resolution are recorded every 30 min. In the absence of rain, especially during the dry winter months (April to September), IPMet’s S-band Doppler radars are well suited to monitor and track the plumes from large biomass fires until they reach the location of the Lidar. So far, three field campaigns of 1-4 months duration have been carried out in Rio Claro, Bauru and Ourinhos, with the Lidar and Sodar being co-located, quantifying pollutants and aerosols in the Boundary Layer and monitoring their dispersion, as well as observing Cirrus clouds □13 km.

The quantification of the PBL pollution load in Metropolitan São Paulo, as well as of the emissions generated by biomass burning in the rural areas in the central and western State is of great importance, as it has an immediate impact on the health of the population. Additionally, Cirrus clouds, and especially subvisual cirrus, play a fundamental role in the radiative balance between the atmosphere-Earth system, actuating as a radiative forcing. An appropriate method has been proposed to determine their optical and physical properties by establishing a Lidar Ratio (LR) with high vertical resolution, where the clouds present the same micro- and macro-physical properties, in order to derive a classification, that could also be applied to other regions.

A typical case study of a sugar cane fire in the Ourinhos region will be presented, demonstrating the integration of all types of data into one coherent event. The first echo of a smoke plume was detected by the Bauru radar on 26 August 2010 at 00:08 LT, about 35 km north-north-east of

Ourinhos and ca 85 km south-west of the radar, rapidly gaining in area and intensity (≤40 dBZ near its origin). By 00:22 LT, the TITAN Software could already identify its centroid of □10 dBZ reflectivity and tracked it until 02:45 LT, when the plume had already spread over Ourinhos, where the Raman Lidar and Sodar were located. As the plume moved southwards with the northerly winds, the aerosols spread out (dispersed) and the reflectivity dropped gradually, but it could still be detected by the radar until 03:46 LT, >20 km south of Ourinhos, using a reflectivity threshold of –6 dBZ. The Lidar observed the arrival of the plume at 02:40 LT between 350 and 600 m AGL. The top of the PBL extended to ca 2,6 km AGL, above which a very dry and relative warm and clean air was advected from the west, creating an elevated inversion which blocked further upward mixing. The lowest layer ≤250 m AGL appeared clean, being trapped within the surface inversion, inhibiting downward mixing, also confirmed by the Sodar measurements, indicating a very stable layer. Lidar data from the Raman Channel (non-elastic signal at 607 nm) were integrated into hourly means until 09:00 LT to obtain the Aerosol Optical Depth (AOD). The results confirmed a high aerosol load of the atmosphere, with hourly mean values of AOD varying between 0,265 and 0,288 until 07:00 LT, after which they increased to 0,433 by 09:00 LT. Hourly means of the Lidar Ratio confirmed the arrival of the plume between 02:00 and 03:00 LT, while an almost 20% increase of LR to 72 sr after 07:00 LT was probably due to downward mixing of the aerosols accumulated above the inversion, also confirmed by an increase of AOD values from the Raman signal. LR values of around 70 sr suggest aerosols originating from biomass burning. Chemical analysis of aerosols and atmospheric gases from samplers co-located with the Lidar, as well as imagery from an afternoon overpass of the MODIS-AQUA satellite corroborate the observations.

In conclusion, it is proposed to conduct simultaneous Lidar observations in La Réunion, South Africa and in the State of São Paulo during the forthcoming TRO-Pico Campaign in Bauru (January / February 2012), to quantify the westward water vapour transport in the lower stratosphere by tracking and categorizing Cirrus clouds along the □22□ latitude, using observations from the four Lidars and trajectory models.