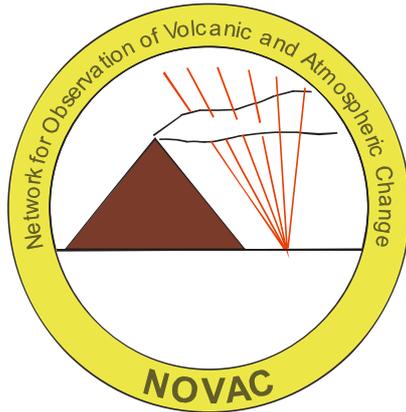


NOVAC

Network for Observation of Volcanic and Atmospheric Change



Specific Targeted Research Project:

Sub-Priority 1.1.6.3 Global Change and Eco-systems

IV.1 Natural Disasters

IV.1.2 Volcanic risk assessment

Project No: 18354

Deliverable 1.2.g

PM from the second annual meeting

2009-05-25

NOVAC SECOND ANNUAL MEETING

Manizales, Colombia
29th October – 2nd November 2007



Participants:

Patricia Ponce	INGEOMINAS
Bety Silva	INGEOMINAS
Ulrich Platt	UHEI
Christoph Kern	UHEI
Leif Vogel	UHEI
Vladimir Conde	UES
Rodolfo Olmos	UES
Bo Galle	CHALMERS
Gustavo Garzon	INGEOMINAS
Eliecer Duarte	OVSICORI
Giussepe Salerno	INGV
Ligdamis Gutierrez	INETER
Cristian Santacoloma	INGEOMINAS
John Makario Londoño	INGEOMINAS
Amparo Coral	INGEOMINAS
Ricardo Mendez	INGEOMINAS
Leonardo Fabio Arias	INGEOMINAS
Cesar Vega	INGEOMINAS
Santiago Arellano	IGEPN
Silvana Hidalgo	IGEPN
Freddy Vasconez	IGEPN
Francisco Montalvo	SNET
Gaia Pinardi	BIRA
Sofia Navarro	INGEOMINAS
Martha Calvache	INGEOMINAS
Zoraida Chacón	INGEOMINAS
Claudia Rivera	CHALMERS

Agenda for the Second Annual NOVAC Meeting, Manizales, Colombia 29 October – 2 November

Monday 29 October			
Time	Activity	Remark	Person in charge
9.00-9.30	Welcome		Ricardo Méndez, Bo, Gustavo and Martha Calvache
9.30 – 10.00	Agenda of the meeting, practical details		Bo and Gustavo
10.00 – 10.30	Volcanic risk assessment in Colombia		Martha Calvache INGEOMINAS
10.30 – 12.00	Scientific reports by partners	Each group should prepare a 15-20 min. presentation of their activities during the past year	All partners
12.00 – 13.00	Lunch		
13.00 – 15.00	Scientific reports by partners		
15.00 – 15.30	Coffee break		
15.30 – 18.00	Special reports		Contributions are welcome. Contact Bo and Gustavo, give title and duration
	NOVAC Instrument ver.II	UHEI	
	The NOVAC Database	UHEI	
		BIRA	
	Spectrometer characterization	BIRA	
19.00 -	Dinner		

Tuesday 30 October			
Time	Activity	Remark	Person in charge
9.00-10.30	Administrative issues		Bo
	Annual Reports		
	Revised time schedule	Prolongation?	
	Revised deliverables and milestones	Prolongation?	
	Equipment budget status		
	Installation plan		
	Meetings	IAVCEI gas	

		workshop, IAVCEI general assembly, 3 rd Annual meeting AGU	
10.30 – 11.20	NOVAC Instrument version II	UHEI	Christoph
11.20 – 11.40	Monitoring of SO ₂ from satellite: the Support of Aviation Control Service of PROMOTE and the role in NOVAC	BIRA	Gaia
11.50 – 12.00	New possible spectrometers	UHEI	Ulrich Platt
12.00 – 13.00	Lunch		
14.00 – 14.20	Report of volcanic monitoring from UES	UES	Rodolpho
14.20 – 14.30	How to model volcanic activity using gas data	INGEOMINAS	John Londoño
13.00 – 14.00	Experience from installed NOVAC instruments	All partners who have NOVAC stations should give a report; Statistics (scans/day), hardware/software problems, training needs.	IGEPN, UNAM, INETER, SNET, INGEOMINAS, OVG, IPGP, INGV
14.00 – 15.00	Actions for improvement	New hard- and software, modelled wind, training?	Chalmers, UHEI, BIRA
15.00 – 15.30	Coffee break		
15.30 – 18.00	Special reports, other topics		Contributions are welcome. Contact Bo and Gustavo, give title and duration
	Flux error discussion	Chalmers, UHEI, BIRA.....	
	UV Scanner DOAS data retrieved using a modeled reference spectrum	Giuseppe Salerno	
	Flux errors connected with radiative transfer and recommendation on how to flag data	UHEI	
19.00 -	Dinner		

Wednesday 31 November

Time	Activity	Remark	Person in charge
9.00 – 10.00	Flux calculation overview		Bo, Claudia
10.00 – 11.00	Data quality flagging?		Chalmers, UHEI, BIRA....
11.00 – 12.00	Examples of flux calculations		Claudia
12.00 – 13.00	Lunch		
13.00 – 16.00	Training on flux evaluation	All partners who have NOVAC stations should bring data.	Claudia, Christoph
16.00 – 16.30	Coffee break		
16.30 – 17.30	Decisions	Prolongation 1 year	Bo
		5% of equipment for met. modeling	
		10% of equipment for travel and installation	
		AGU 2008	
		Next Annual Meeting	
		Instrument status protocol	Santiago
		Conference dinner	Gustavo
	Agenda 2 Nov.	Bo and Gustavo	
	Steering Committee meeting		Bo, Ulrich
18.00 – 19.00	Dinner		
19.00 – 21.00	Tour of Manizales		INGEOMINAS

Thursday 1 November

Time	Activity	Remark	Person in charge
9.00 – 19.00	Field trip to Nevado del Ruiz		Gustavo
	Administrative problems helpdesk	If needed	Bo
20.00 -	Conference Dinner		Gustavo

Friday 2 November

Time	Activity	Remark	Person in charge
9.00 – 19.00	Field work at Nevado del Ruiz		Gustavo
	Administrative problems helpdesk	If needed	Bo
20.00 -	Dinner		

29th October 2007

The meeting starts at 9:22. Bo welcomes everyone to the Second Annual Meeting. Ricardo Mendez (Coordinator of Vulcanological Observatory in Manizales), representing the General Director of INGEOMINAS welcomes everyone to the meeting. He explains that the Subdirector of INGEOMINAS, Martha Calvache, will arrive later to the meeting. All the participants then present themselves.

Practical details about arrangements are then discussed by Gustavo Garzon, meteorological conditions at Nevado del Ruiz, lunch and coffee breaks. The preliminary agenda is discussed: scientific reports, administrative issues, organization for everyday dinner, flux error discussions, training on flux calculation and evaluation and finally field work days. The importance of scientific and annual reports is then stressed and during the meeting, time will be allocated to discuss them.

10:15 – 10:40 Coffee Break

At 10:40 Bo starts with Chalmers scientific report presentation. The working group is presented and the main activities of the group during last year. Some scientific management activities done last year were: Mobile DOAS training in Nicaragua, arrangement of NOVAC training and seminars in Nicaragua, arrangement of 2 spectroscopy and 2 instrument meetings and the submission of a proposal for a “Marie Curie Training Network” linked to NOVAC. Also administrative activities and dissemination of results activities were presented. Instruments have been continuously improved: observatory software (wind-speed, plume height), electronic board, software for real time monitoring of data via Chalmers FTP-server.

Also 26 instruments were built, calibrated and tested. There are already installed instruments at: San Cristobal (3), Masaya (2), Tungurahua (2), Popocatepetl (3), Nyiragongo (3), Piton de la Fournaise (3) and under installation: Cotopaxi (1), Galeras (1), Tungurahua (1), Colima (2), Nyamulagira (1) and Etna (2).

Improvements on internet and network were also done: software to facilitate downloading of data in the field, improved observatory (instrument communication), successful implementation using FTP at Piton de la Fournaise, Reunion Island.

10:55 Francisco Montalvo, Gaia Pindari, Sofia Navarro and Martha Calvache present themselves.

At 11:05 Eliecer from OVSICORI gives his scientific report presentation. Eliecer explains the work of OVSICORI, normally they work with 5 volcanoes, but recently Turrialba volcano has been very active. An explanation of Turrialba’s damaged vegetation due to gases volcano is made. Burned vegetation around Turrialba is shown. Regular pictures have been taken to see the impact of gases on vegetation over time. A schematic representation of how the plume develops is then explained. Turrialba’s latest activity was 140 years ago, the population is worrying about the activity. Rapid increase of temperature and release of gases is also present. Also fractures have been developed and new fumarolic activity. The impact of vegetation is worsening and is spreading around the volcano. Grass for livestock is being

affected, there is concern since many people depend on livestock for survival. Fauna has been killed due to gases (domestic and wildlife). Seismic activity has also been increasing. Furmaroles temperature have increased from 90 to 137 degrees. Flux measurements using mini-DOAS have been made. During 2002, measured fluxes were of 1 t/day, but during 2007 fluxes have been quantified between 65-100 ton/day.

At 11:30 Gustavo Garzon from INGEOMINAS gives his scientific report presentation. During the past year, work on dissemination of results, exploitation of data for local volcanology, local impact of gas emissions, implementation of risk assessment and work on satellite validation has been made. A presentation about NOVAC was made during November 2006 at the Geophysics Institute of Panama. Also during August 2007, the NOVAC project was presented at XI Colombian Geological Congress in Bucaramanga, Colombia. A scientific paper is also in preparation.

Three UV Scan DOAS systems were installed recently (October 2007) at Galeras volcano. Mobile-DOAS measurements have been made at Nevado del Huila, Galeras, Purace, Cerro Machin, Nevado del Ruiz and Cumbal. Presently the most active volcanoes are Nevado del Huila and Galeras.

An explanation about the volcanological monitoring in Colombia is then made. Nevado del Huila volcano has been recently very active, emissions using Mobile DOAS have been reported as 11363 ton/day (April 11th, 2007), 13650 ton/day (April 24th, 2007). In June 1st, 2007 early in the morning emissions were down to 3076 ton/day (helicopter); the same day at mid day the emissions were about 3391 ton/day (car).

At Nevado del Ruiz, 370 ton/day were measured using MobileDOAS during June 26th, 2007.

A graph showing SO₂ emissions (MobileDOAS) and Long-Period released energy of Nevado del Huila volcano was then presented. Statistics of contribution of SO₂ emissions to the atmosphere of Colombian volcanoes is then presented. Nevado del Huila has increased its background emissions (600-2500 ton/day) up to max 13,000 ton/day. Galeras has increased from background emissions (600 ton/day) to 1,600 ton/day).

At 11:45 Ligdamis Gutierrez gives INETER scientific report presentation. He explains the installations that have been made at Masaya. Both Caracol and Nancital stations are presented as well as some example of data from the stations and flux calculations. Then San Cristobal installations are presented, as well as some examples of downloaded data from the instruments and flux evaluations. San Cristobal's network is then explained as well as Masaya's network and freewave radios configuration of Masaya and San Cristobal. The designs of both Masaya's and San Cristobal's installations are then presented. A discussion about the problem of obtaining a complete plume at Masaya was discussed. Also data transmission problems were discussed. Bo explains that a new program has been made to download data from the instruments using ftp in a quicker way.

12:00 – 13:40 Lunch

At 13:40 Martha Calvache gives a presentation about the Activity at Galeras and Nevado del Huila Volcanoes: evaluation and disaster prevention. Volcanic unrest at Galeras and Nevado del Huila volcanoes is addressed. INGEOMINAS is the Colombian institute of Geology and

Mining, it comprises three observatories: Pasto, Manizales and Popayan. For volcanic hazard evaluation purposes, characterization of the hazards is needed. Historic and recent activity at Galeras is then presented as well as the volcanic hazard map. The main concern is the people leaving near the volcano, even when the volcano does not present severe eruptions.

A geological map of Nevado del Huila volcano is then presented, at the south part, flank collapses are likable. The hazard map of Nevado del Huila is also presented as well as the monitoring network and monitoring instruments. A thermal camera is also used both at Galeras and Nevado del Huila volcanoes as well as SO₂ monitoring equipment.

The activity of Galeras is then presented in a graph: long period seismic activity, volcano-tectonic activity, etc., are shown between 1st January 2004 – July 2007.

Nevado del Huila activity (february–july 2007) is then presented: the volcano was generally very quiet and in a period of two days the volcano tectonic activity increased (19th February 2007). Seismic signals on February 18–19th 2007 were presented showing the increase in activity of the volcano from February 18th to February 19th.

In order to prevent disasters, several activities were carried out:

- a) Community communication: in Galeras there is big scepticism on the activity of the volcano; on the other hand in Nevado del Huila there is good organization and there is acceptance of the danger of the volcano.
- b) Inter-institutional work: difficult since there are different points of view, it is difficult that institutes work together.
- c) Drill (June 18th, 2005) in Galeras
- d) Work with indigenous community
- e) Shelters to accommodate the community in case of evacuation
- f) Visit to Tungurahua volcano, Ecuador helped to change the perception of people from Galeras about a volcanic eruption

Early warning and alerts for Galeras volcano has been seismic activity, however during the latest activity period this was not the case.

For Nevado del Huila, a small swarm was detected on April 17th 2007 and this was informed to the community. During night time the seismic activity continued and a second communication bulletin was released. Early in the morning on April 18th the eruption took place.

The accomplishment of Nevado del Huila crisis: 0 fatalities, 0 injured people, 0 missing people, 16 destroyed bridges; at 80 km of the volcano, down the river about a flow of 130 m³/sec to 1300 m³/sec. At 150 km from the volcano, around 10 millions m³ of water arrived; indicating big lahar descending from the volcano.

Finally the people working in each observatory were mentioned as well as joint projects with different organizations.

At 14:15 Francisco Montalvo from SNET presented their scientific report. San Miguel volcano presents now increased seismic activity, small changes of fumaroles are reported. In October 2006 the seismic activity of San Miguel started to increase as well as SO₂ flux from the volcano.

In march 2007, Santa Ana volcano had a new volcanic crisis. The different stages of Santa Ana lake were presented, the lake finally disappeared but the seismic activity did not increase much.

Presently the motor of the scanner is broken and SO₂ measurements can only be made using mobile instruments.

At 14:25 Silvana Hidalgo presents the activity report during the second year for IGEPN. The main topics covered are installations, problems, implementation of NOVAC system in local monitoring activities and plan for the next year.

At Tungurahua three instruments (two single and 1 double) have been installed: Huayrapata hill, Bayushing town and Pillate town. Huayrapata station has a direct link to OVT, Bayushing station needs 1 repeater to OVT, Pillate station also needs 1 repeater to OVT (Huayrapata). For Cotopaxi station one site has been prepared.

The problems IGEPN has had:

Volatile memory on the electronic unit: the cfg.txt configuration file was removed of the unit.

Data archiving

Problems with time acquisition using GPS

Minor problems with internal routines of the NOVAC program

There are also administrative problems regarding money transfer.

The activities of the observatory are: Re-evaluation of fluxes (wind information obtained from satellite or local airports). Statistical analysis with software developed in the IGEPN. Results are reported and compared with other gas measurements.

Plan for next year: finish installations at Cotopaxi, improve flux evaluation with better constrained wind information.

At 14:35 Bo Galle explains about installations at Nyiragongo in July 2007. There have been problems of data transmission. Additionally because of political unrest the instruments have been taken down.

In 2004 a scanning instrument was installed at Rusayo station, it has been running with few interruptions. Two additional systems were installed in July 2007: Sake, Kunene. In addition Rusayo instrument has been upgraded. Both Rusayo and Kunene have a direct link to OVG. Sake station needs a repeater (Buzi) which happens to be a good site for instrument installation, in the future a system will be installed in this site. The combination of data from Rusayo and Buzi stations can be a good possibility to study plume chemistry.

In Nyamulagira is military impossible to install instruments at the moment. Discussions are still going on about the decision of whether install more instruments at Nyiragongo.

The installations at Rusayo, Sake and Kunene are shown: mainly a big pole where the scanner is and all electronics and instruments inside a box either inside or outside stations.

At 14:50 Claudia Rivera presents UNAM scientific report presentation. The main topics covered were the installations of three stations at Popocatepetl volcano. The three stations were presented and the installations explained. Some issues related to data transfer were discussed.

At 15:05 Christoph Kern presents UHEI scientific report. A study on data evaluation and error estimation was made.

Test installations of NOVAC version II instruments at Stromboli volcano in March 2007 were made. At Stromboli two instruments were installed, some data from this two installed instruments was presented.

An intensive campaign including active DOAS measurements at Masaya volcano in Nicaragua was also made. Installation of NOVAC version I instruments at Masaya, Mobile-scanning instruments (version II) were also done. Long path instrumentation was used in Masaya, an explanation about the system and data from this field campaign was presented.

Satellite evaluations of SO₂ from Nyamuragira volcano (using SCHIAMACHY data) were also presented.

The project of a construction of an “SO₂ camera” was also explained, the objective was to image SO₂ column densities in volcanic plumes. The first measurements using this “SO₂ camera” were presented.

At 15:30 Bo Galle presents the installations performed at Reunion Island (Piton de la Fournaise) in September 2007. Piton de la Fournaise is not erupting at the moment. Last eruption of the volcano was during April 2007. Normally winds come from East. Three stations were installed west of the crater: Piton Partago, Enclos0 and Piton de Bert. The objective with the installation setting was to cover most of wind directions. In this volcano the problem of incomplete plume could be faced, just as in Masaya case. Some pictures of the installation sites were showed. Heavy rain is common at Piton de la Fournaise. Upon arrival to the volcano, the infrastructure for installations was already prepared, including a WiFi network. Because of this the installations did not take much time and the three systems could be installed in less than 2 weeks.

At 15:45 Cristian Santacoloma from Popayan’s Volcanological Observatory gave a presentation about Nevado del Huila volcano activity. A description of surveillance stations at Nevado del Huila volcano were shown (mudflow monitoring network). The accumulated released energy by Nevado del Huila volcano between January–October 2007 was presented as well as the seismic activity. The number of events had two peaks: one on February 19th and a second in April 18th 2007. In addition El Oso glacier lost some of its mass. Some statistics of the activity of the volcano were also presented as well as thermal images of the volcano on April 30th and AURA–OMI Satellite images of the eruption.

16:05 – 16:45 Coffee Break

At 16:45 everyone is back. Coffee breaks, lunch and dinner were then discussed.

Leif Vogel continues presenting the NOVAC Database (16:55). Presently the NOVAC database contains scans and spectra from 5 volcanoes but lot of more data is expected so high performance of the database is needed. Data will be automatically imported from the ftp-server in Chalmers: raw data (pak files) and processed data (logfiles) are expected, both types of files are stored locally and re-stored matching the measurement date.

There are three search-levels in the database: scans, spectra and scans & spectra. There will be multiple options for searching, sorting and viewing. Everything is downloadable from the database. Presently data from 5 volcanoes has been downloaded.

The final database server is installed at Heidelberg and is at the final stage of configuration. The next step is performance optimization; it will be completed by 01/01/2008. It is needed to test the database so everyone is encouraged to apply for an account and start to download data.

The server hardware and software details and costs were then explained. The server is FUJITZU SIEMENS PRIMERGY RX300S2 and it has uninterruptible power supply. The final configuration will be completed by end of the year.

The NOVAC database server website is: novac.iup.uni-heidelberg.de, for any questions contact Thomas Lehmann (thomas.lehmann@iup.uni-heidelberg.de). The database was then accessed and the use was explained. The question of the location of postfluxevaluation-log file is raised as well as dynamic queries.

Gaia Pinardi (17:25) continues presenting the characterization of S2000 and SD2000 spectrometers at BIRA-IASB. Large variability from one instrument to the other was found. Stray-light is unavoidable in single grating spectrometers and can be a significant source or error/incertitude for optical absorption measurements, especially in the UV range. It can be handled by hardware or software. At BIRA spectral stray-light was measured in different spectrometers and corrected for. Stray-light correction was difficult for S2000 spectrometers because of their limited dynamical range (4096 counts). The advantage of the stray-light method technique is the characterization of the error done when considering a constant offset over the whole detector range. The error on stray-light contribution was accounted from 1.5% to 4% (for the shown example).

Also temperature effects were accounted for both S2000 and SD2000 spectrometers. The temperature range was 6.8 to 40 degrees. The effect of temperature varies among spectrometers (large differences were found). Variation of temperature was also found to induce slit changes, shift variation as well as resolution variation. The electronic offset also needs to be adjusted because it changes with temperature.

In conclusion: regarding resolution about 10% error is expected, errors due to stray-light are expected to be about 4%.

The last presentation ends at 17:55.

30th October 2007

The meeting starts at 9:20 discussing the agenda, some changes during the morning session were made in order to catch up with the presentations that were not possible to take the day before.

Bo Galle (9:25) starts with a status of the annual reports delivery (scientific report, management report, cost statement and signed cost statement) of all the partners. In the scientific report some results should be showed. In the management report a summary of costs (justification) and general information should be included. The cost statement is a form to request for money, an explanation of how to fill it in was made. All the reports should be ready by November 15th, 2007.

The idea to have audit certificates is to prove that expenses have been made. The importance to have an audit early in the project for all partners is stressed. There is additional budget for audits; in this case there is no economical reason for not doing audits. The auditor should be authorized to do audits and should also be external from the observatory.

The possibility of a prolongation of the project was then discussed. With the original plan there is only one year left to finish installations. But because of some problems of spectrometers delivery and the addition of 4 more volcanoes, the suggestion of adding one more year of the project is raised and in this case having one more year of data at the time of writing the final reports. If there is a prolongation of the project, all deliverables due to last year will be pushed one more year and there will be no extra money. Some extra money for travel will be needed since one more Annual Meeting will take place.

A preliminary estimation of the equipment cost overview for all partners is presented. All partners except for INGV have money for instruments in two volcanoes. Because of negotiations with suppliers the equipment costs were reduced and there is equipment money left. Up to 10% of the total equipment budget can be used for installation costs or travel costs. Installation costs do not include solar panels, batteries, regulators or radio link hardware. An estimation of equipment cost options was given:

Double scanner (ver1)	6000 euro	
Single scanner (ver1)	5000 euro	
Mobile DOAS	2800 euro	
Scanner ver 2 (Heildelberg)	7500 euro	
Met model (5%, 1620/volcano)	3240 euro	
Travel + installation (max 10%)	6480 euro	(for 2 volcanoes)

A suggestion of spending 5% of each volcano allocated money on running a meteorological model is raised.

Some possible installation period was then discussed; the goal is that each partner has instruments in at least 1 volcano. In this case there is still need to install instruments in El Salvador, Guatemala and Costa Rica.

Next there was some discussion about the Third NOVAC Annual Meeting. One possibility was an IAVCEI gas workshop during next year; however this meeting will not take place. The latest news is that it will be in Mexico, but the dates are not known.

There is a plan for an International Meeting on Arenal volcano next year during July in Costa Rica, however it is not an option because of the dates.

Another possibility is to have the Third NOVAC Annual Meeting in connection with AGU 2008 in San Francisco during December next year.

Christoph Kern (10:50) continues presenting Instrument Hardware NOVAC Instrument Version II. The instrument schematics is presented and explained. The instrument status is: 7 instruments have been constructed, they have been successfully tested at Mount Etna, Italy (2006), San Cristobal and Masaya, Nicaragua (2006). Two instruments were installed at Stromboli, Italy (March 2007). Further measurements have been made at Masaya (April 2007) and Etna (August 2007). Two more instruments are ready for installation at Mt. Etna.

Among improvements implemented in the last 12 months are: adaptation of HR2000 spectrometer in place of HR4000 (software and spectroscopy issues resolved), addition of direct solar mode, temperature issues largely solved (additional fan).

The special characteristics of this instrument are: scanning scheme entirely set by software (flexible: plume scans, wind measurements, tropospheric and stratospheric components), exclusively achromatic optics, no polarization sensitivity, high resolution (0.4nm FWHM), determination of instrument-orientation from solar position possible as well as direct sunlight measurements capabilities.

Next the different measurement modes were explained: scans, wind speed measurements, direct sunlight measurements (for this the sun needs to be behind the plume). The advantages of direct sunlight measurements were also explained. Direct sunlight measurements were performed at Mt. Etna (last week). The impact of enhanced resolution of the used spectrometer is then explained.

The power consumption of the scanner is then discussed; the big issue is the temperature controller which can take between 0-50W. A cost estimate of the instrument is then discussed.

Some deployment possibilities of the instruments are then discussed. Installation examples of the instrument at Stromboli are shown.

Finally some conditions to think about if one wants to install these instruments are:
Adequate security: instrument is installed in the open (working on alternative installation configuration for near future)
Power considerations: temperature control requires additional power (not necessary all the time)
Interest in more advanced data acquisition and exploitation (additional measurement modes can be interesting, but require some training and initiative).

Gaia Pinardi (11:20) then presents a study about monitoring of SO₂ from satellite: the support to aviation control service of PROMOTE and the role in NOVAC. PROMOTE stands for "Protocol Monitoring for the GMES Service Element: Atmosphere" and the aim is to deliver

near-real-time data derived from satellite measurements regarding SO₂ and aerosol emissions possibly related to volcanic eruptions.

Using SCHIAMACHY data, SO₂ slant and/or vertical columns are analyzed and email alerts are sent in case there is an “exceptional SO₂ concentrations”. There are predefined regions; there are 42 volcano regions of 30 by 30 degrees. Maps are made for SO₂ and cloud cover information based on SCHIAMACHY data, the use of OMI data is currently being added.

SO₂ is retrieved in the range of 315–326 nm: SO₂ and ozone are fitted at two temperatures (223 and 243 K). However there is still interference between SO₂ and ozone, in this case a correction is made.

An example of a notification of “exceptional SO₂ concentration” is then shown. The main information is process date and time, instrument used, Volcano region, maximum SO₂ content, etc. Some more examples of detected “exceptional SO₂ concentration” at different volcanoes were shown.

Some web links of interest:

<http://www.temis.nl/aviation/so2.php>

<http://sacs.aeronomie.be/>

Bo Galle (11:50) then gives a short explanation about GlobVolcano project.

Ulrich Platt (12:00) presents the possibility to have new spectrometers for NOVAC. First some issues with ocean optics spectrometers were presented. A new possible supplier is omt-optische messtechnik gmbh, the size is about the same of the ocean optics spectrometer. It has many gratings and slit width available as well as cylinder lens option. The cost is around 4000 euros but it can be negotiable. The detector is back-illuminated CCD (like Hamamatsu S10140). In summary the omt spectrometer may be a solution to most of the problems associated with ocean optics miniature spectrometers, however we should be careful with changes. Two spectrometers were ordered and will be tested. A discussion about ocean optics spectrometers follows.

12:15 – 13:15 Lunch

After lunch a demonstration of the NOVAC Instrument version 2 (Heidelberg) was made.

Then Rodolfo Olmos (13:50) continued with a presentation about University of El Salvador activities during last year. CO₂ and SO₂ values showed increased values before both Santa Ana and San Miguel eruptions.

Next John Makario (14:15) gave a presentation about Temporal Changes in Seismic waves attenuation related to gas content, as a tool of forecasting volcanic activity at Nevado del Ruiz Volcano, Colombia. The relationship between seismic wave attenuation (Q^{-1}) and SO₂ emissions was addressed in this study. Q^{-1} = attenuation of seismic waves.

Coda Q is the quality factor of the media. Coda waves are the “tail” or last part of a seismic event or earthquake. It has been used as a possible tool for earthquake forecasting (Jin and

Aki 1986; Sato 1987). Temporal changes of coda Q have been observed before volcanic eruptions.

Hypocenters of earthquakes of Nevado del Ruiz volcano were used in this study. Q can be separated on intrinsic, scattering and total attenuation. Intrinsic attenuation is a good tool for monitoring thermodynamics of the volcano.

A correlation between Q^{-1} and SO_2 flux (measured using COSPEC) was found. SO_2 flux can be used as an approximation of gas content inside the volcano and correlated with seismic attenuation.

Santiago Arellano (15:00) gives a presentation about some results of the first year of activities. IGEPN has done some local developments: in-house software for data analysis, station maintenance register, summarized operator manual distributed to NOVAC-users in the Observatory, data archive, data backup, acquisition of spare components with local funding (1 station). The in-house software interface is explained, the software reads the post evaluated data. There is need to include statistics on all NOVAC Program versions. Statistics about both Bayusig and Huayrapata stations were given as well as flux results. The main training needs are: wind speed measurements by the autocorrelation method, MobileDOAS, error analysis incorporating measurement and path effects, data retrieval strategies and measurement of other species (e.g. BrO).

Patricia Ponce (15:25) continues presenting experiences of installations at Galeras volcano. Initially a scanner was installed at Ancuya and data was transmitted by FTP (july-september 2006). There was a problem with internet connection and the system was moved to the observatory on September 2006. During this year work has been done to find possible installation sites as well as repeater sites: Santa Barbara, Alto Jimenez, Alto Tinajillas are the three chosen stations. Two repeaters are needed. At the moment only the protection systems are installed due to administrative issues.

Some mobile measurements have been made. With increased seismic activity, the recorded SO_2 flux data has been also increasing. Some measurements have been also made using a scanner: a person from the observatory drives there and performs measurements.

Ligdamis Gutierrez (15:40) gives some comments about how the scanners in Nicaragua have been working.

Bo Galle (15:42) continues giving a summary about the problems the scanners have had: flash memory, the need to reformat the memory is then mentioned. Some changes have been made in software. Also the possibility to change the computer is mentioned. The importance to keep an instrument log where important changes are registered is stressed. At this point it would be very useful to have a regular instrument log.

16:05 – 17:00 Coffee Break

After the coffee break arrangements about the dinner of the day were made.

Bo Galle (17:05) continues with errors discussion. First of all the spectroscopical error needs to be taken into account and the final effect on the evaluations are in the order to 10% for a non temperature-controlled spectrometer.

The second error is the meteorological data error. If there is an error on plume height of for example 20% then we will have 20% error on flux estimation.

The geometrical error deals with the geometry and location of the plume. When the plume is incomplete and when the highest column of the plume is not in the centre, also an error is expected.

Another error is wind speed and wind direction error. Error in wind speed affects more seriously to flux calculations than wind direction error.

The scattering error is then explained, it can be divided in: light path extension inside the plume and light dilution.

There are various possibilities to handle errors, the data can be easily flagged as “good” or “bad” or a more detailed handling of error could be made.

Giuseppe Salerno (17:15) continues presenting some results about the scanners network installed at Mt Etna. The performance of DOAS SO₂ retrievals using a modelled reference spectrum was investigated. The methodology followed was using clear-sky (no plume), in this case spectra were collected viewing through either 130 or 344 ppm m cells and data was analyzed. It was observed that retrievals were under-estimated in early mornings and late in the afternoons. The errors varied according to the hour of the day and the viewing angle. Also seasonal effects on multiple scattering were addressed. The relative difference among months was about 1%. Further work still needs to be done to improve the understanding of the energy transfer in the long-time analysis using a radiative transfer model.

Christoph Kern (17:45) continues with a presentation of radiative transfer in and around volcanic plumes. The main error sources or error are: spectroscopy error, geometric error, wind error and radiative transfer error. The ideal conditions for a measurement were then explained as well as a “dilution” effect. Multiple scattering effect is also explained. Even during ideal measurements conditions the dilution and extension effects counteract, however quantification of both is necessary to determine accurate fluxes. If located above the plume, clouds play a secondary role, in this case photon paths will be extended, but the path in the plume will remain the same. The influence of clouds or fog below the plume is a bit more complicated and very difficult to deal with.

As a procedure for dealing with radiative transfer it is important to: qualitative understand effects, flag data, quantitative understand the effects (O₄ absorption, wavelength dependent effects, radiative transfer models) and reduce and correct error of radiative transfer effects. An example of TracyII GUI was showed. In summary, radiative transfer can greatly influence retrieved trace gas column densities (errors > 100% possible).

A suggestion to flag data is to have “green”, “yellow” and “red” values. Some examples of ideal, medium and poor conditions were shown.

Green: ideal (error < 25%)
Visibility > 25 km at ground and,
Blue sky of clouds clearly above the plume and
Little or no condensation in the plume

Yellow: moderate (error < 60%)
Haze, visibility < 25 km at ground or
Plume no transparent
Clouds possible, but still above the plume

Red: poor (no flux evaluation possible)
Low clouds or fog
Plume altitude not visible from the ground

Some discussion about overview of conditions and error estimates follows.

At 18:20 the meeting ends for the day.

31st October 2007

The meeting starts at 9:40, first the general plan to visit Nevado del Ruiz is discussed, it will be on Thursday. The agenda for the day is discussed as well as the need to have a common way to flag data. There were also discussions about the conference dinner day, it will be on Friday. For the field work, if someone does not have enough equipment (clothes) should talk to Amparo. Amparo will try to arrange to have breakfast at “refugio”. For lunch, the hotel will be asked to prepare lunch boxes.

John Makario (9:52) continues with a presentation of Nevado del Ruiz volcano. Everyone should bring their passport for registration. Possible places for scan measurements are discussed as well as roads for mobile measurements. In order to go to the crater it is necessary to leave early in the morning, around 4:00 in the morning, and probably reach the crater around noon. Also especial equipment is necessary.

Claudia Rivera continues (10:10) with a presentation of flux calculation using the NOVAC Program. The NOVAC Program function of flux calculation is introduced, each feature of the post-flux evaluation window is explained as well as the possibility to use a text file containing wind data in order for the program to interpolate. Also a discussion about how the completeness of the plume is calculated as well as “good” and “bad” data points. An example of how to download wind data from NOAA was also made, the importance to obtain wind data automatically was stressed.

Santiago Arellano (11:05) continues with a talk about the estimation of a “quality factor” and some path effects affecting remote measurement of volcanic plumes. First a presentation of the sources of error due to scattering process is made. The single scattering process is explained. Then an example of how the “quality factor” is calculated at Tungurahua is made. Both modelled and measured intensity are discussed, the wavelength where the comparison takes place is around 320 nm, after the fitting region. Another source of error accounted for is the path effects. If there is a diffusion component added to the wind speed, then a default

value of wind speed is 1 m/s. Also the scanner plume distance is taken into account for quantification of the “quality factor”. When the plume is above the station or about 100 m from it, then that is considered as a good measurement. Some examples about weather quality flagging are presented: A-good conditions, B-regular conditions, C-bad conditions and D-really bad conditions. Scavenging processes of the plume were also deeply discussed. After the presentation a discussion continues about SO₂ removal. It was concluded that plume chemistry could be another error to consider.

A discussion about including a modelled and normalized intensity together with scans information followed. Also width of the plume was discussed as a parameter to take into consideration.

12:05 – 13:35 Lunch

After lunch (13:35) Bo Galle continues with some decisions and administrative issues. First the prolongation of the project is addressed and decided to extend the project.

Next the decision of allocating 5% of the equipment budget to meteorological modelling, in general the audience thinks it is a good idea. Bo will send an email to the principal investigators and they will decide.

The allocation of 10% of the equipment budget for travel and installation is then addressed. If a partner wants to do this allocation of 10% of the equipment budget to travel costs, a request should be sent soon.

Then the place where the next Annual Meeting is discussed, there are two possibilities: AGU 2008, in San Francisco and Alexander von Humboldt International Conference in Santiago de Chile during end of November, 2008.

The possibility to have an Instrument Status Protocol monthly is decided, more information about this will be sent later.

Suggestions about the conference dinner are then made, it will be on Friday evening, and the place will be later decided.

Finally the suggestion to go to Armero in Friday is raised.

Next (14:05) some examples of plume measurements were showed and discussed. The participants tried to reach a consensus about error estimation, the decisions were:

Spectroscopic error 10%

Wind error 30%

Scattering error (as proposed by Christoph):

Green: ideal (error 25%)

Visibility > 25 km at ground and,

Blue sky of clouds clearly above the plume and

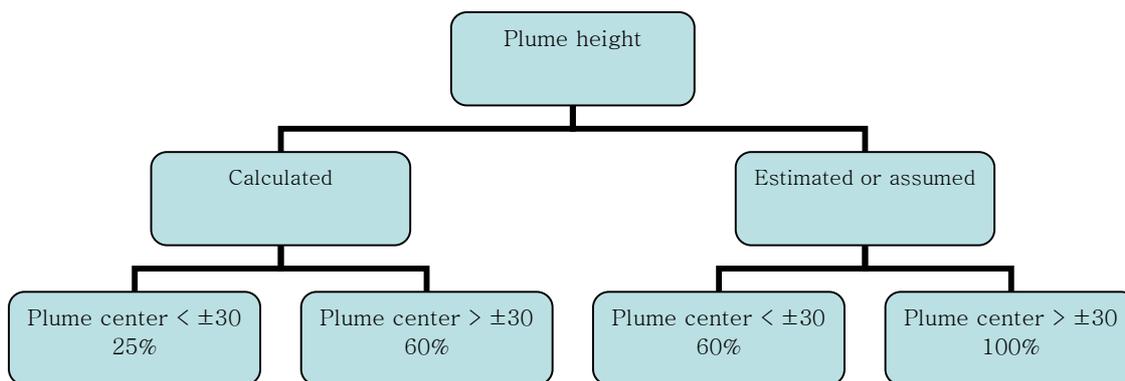
Little or no condensation in the plume

Yellow: moderate (error 60%)

Haze, visibility < 25 km at ground or
Plume no transparent
Clouds possible, but still above the plume

Red: poor (no flux evaluation possible) if calculated flux (error 100%)
Low clouds or fog
Plume altitude not visible from the ground

Geometrical error (depending on plume height and centre of the plume):



These values are preliminary and will be tested. Claudia Rivera will send the participants a protocol about these errors and communications will follow as whether these purposed numbers work or if modifications are needed.

More proposals about how to handle geometrical error were raised by IGEPN and Heidelberg, discussions will continue about the possibility to implement them.

1st November 2007

Visit to Nevado del Ruiz, participants met around 6:00 am to leave for the volcano. Breakfast was taken at “Gualí place”. Some mobile measurements were made by Christoph, Leif and Claudia. Betty Silva joined in the exercise.

2nd November 2007

Visit to Armero by most of the participants. Gustavo Garzon, Ulrich Platt, Leif Vogel and Christoph Kern visited Nevado del Ruiz again. Mobile and scanning measurements were made. The conference ended with a dinner.