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Political and scientific uncertainties in volcanic risk management: The yellow alert in Quito in October 1998

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Abstract

Volcanic risk management involves volcanologists, civil authorities and the affected population. The paper reports on one 'yellow alert' in Quito in 1998. It describes the scientific context, the political announcement and the decision-making process that preceded, as well as the social perception of the volcanic crisis.

Introduction

The specific nature of volcanic risk management lies in the following circumstances: volcanic crises can last a long time, must be managed in a context of great uncertainty, and must be managed utilizing a scale of several stages of volcanic alert. Several authors analyzing communication and interaction between volcanologists, civil authorities and the affected population, demonstrated the difficulties in dealing with the uncertainties inherent in volcanic unrest (Peterson, 1988, 1996; Tilling, 1989; Chester, 1993; Peterson and Tilling, 1993; IAVCEI, 1999; Voight, 1990). Within such a conceptual framework, this paper addresses the various scientific and political issues which arose during the volcanic crisis in Quito, capital of Ecuador, where a 'yellow alert' was declared on 1 October 1998. The yellow alert was announced after scientists at the Instituto Geofísico (The Geophysics Institute, abbreviated in Spanish as the IG) of the Escuela Politécnica Nacional (The National Polytechnical School) registered an abnormal level of activity in the Guagua Pichincha volcano for a period of several weeks. This decision was unprecedented in the history of Quito, and there were no examples of similar crises in comparably sized cities to serve as a reference. In this context, the decision to warn about two million people of what was then an invisible danger was difficult and involved a high degree of risk. Such a decision could be made only in a relatively favorable scientific and political context. Furthermore, this crisis demonstrated that in Quito, the management of volcanic risk could have serious political implications.

This article is the result of a mission carried out by the authors in Quito during the month of November 1998. Its aim is first to describe the scientific context in which the alert occurred. The authors then address the question of the political announcement confirming the scientifically established yellow alert conditions, by analyzing the context in which the decision to inform the public was made, as well as the political risks involved in the decision-making process. They underscore the difficulty of managing a yellow alert in a context of uncertainty and over a long period of time, and conclude with the positive aspects and results of the situation.

Facts, interpretations and conclusions provided in this paper are based on various kinds of data: interviews with scientific, civil and military authorities; analysis of public official communications and daily newspaper reports; compilation of technical reports and municipal emergency plans. This supports the conclusions offered about the decision-making process and the course of managing the volcanic crisis in Quito. Secondly, a survey of about 50 questions presented to 325 people from 10 neighbourhoods selected according to their varying degree of exposure to the volcanic risk, provided the data on the social perception of the volcanic crisis.

The volcanic risk presented by the Guagua Pichincha for the capital of Ecuador

The Pichincha volcano, a single mountain mass composed of two distinct volcanoes, stretches for 25 km along the western side of Quito. The nearest peak, Rucu Pichincha (4675 m), overlooks the city and is an old extinct volcano. Further west lies Guagua Pichincha (4794 m), an active breached caldera, 1.6 km wide and 700 m deep, which opens towards the west. Inside is a lava dome, formed in 1660, which has been the source of steam explosions in recent years. The Guagua Pichincha volcano is situated 15 km west of the centre of Quito. It is an explosive volcano which has known four plinian-type eruptions during the past 2000 years. These occurred in the years 550 and 970, the years between 1566 and 1582, and in 1660. The year 970 eruption is considered the largest, but the one which occurred in 1660 is best known because of the available eyewitness accounts, and is used

as reference by researchers. However, these eyewitness accounts mention 30 to 40 cm of ash over Quito, a figure which scientists now consider a gross exaggeration (CODIGEM, 1994). Since the eruption in 1660, the Guagua Pichincha volcano has only known periods of phreatic activity in 1830–1831, 1868–1869, 1981–1982, 1989–1993 (resulting in the death of two vulcanologists of the IG in 1993), and in 1997. However, given the average periodicity of the plinian eruptions – every 500 years during the past 10,000 years – the probability of an eruption occurring within the next few decades is quite high. The hazards of Guagua Pichincha are relatively well known. They are a function of three factors: the magnitude of the eruption, winds direction, and the blocking effect of Rucu Pichincha.

Thanks to the latter configuration, Quito should be protected from pyroclastic flows (especially lateral blasts) – some of the most dangerous phenomena. The development of a plinian column could cause the collapse of the eruptive column, as well as lapilli and ash falls. However, given the dominant winds, most of the volcanic fallout should reach the regions west of the volcano. On the other hand, if the winds change and blow eastwards, as it sometimes occurs, the consequences would be serious for the city of Quito: more or less total darkness, health problems, breakdown of public services and utilities (water, electricity, sewer system, etc.), breakdown of communications, paralyzation of economy activity. According to a simulation made by CODIGEM (national geological bureau) with Italian technical assistance, if an eruption similar to the one in 970 occurs, with winds blowing eastwards at 7.5 m/s, 20 to 30 cm of ash and lapilli would fall on Quito (CODIGEM, 1994). In addition, if the ash fall is 15 to 20 cm thick, roof collapse is likely to occur in the old colonial center of the city and in the low income neighbourhoods where poorly constructed buildings are especially vulnerable. This delayed danger would be accelerated and amplified by rainfalls.

Volcanic mudflows, or lahars, are the second type of dangerous phenomenon. They are caused by the blocking of ashes by water resulting from the atmospheric phenomena provoked by the eruption, and by water flows in the ravines or 'quebradas' which cut through the volcano. These flows could happen on the western side of the capital, which is heavily urbanized (approximately 75,000 inhabitants), and could affect the flat part of the city, in particular right below the quebradas. The sectors at risk and the degree of risk are evaluated differently depending on the research, the scenarios and the parameters taken into account (Peltre, 1994; CODIGEM, 1994; EPN-MDMQ, 1998). However, it is clear that lahars occurring during the eruption or, more likely, after the eruption, would cause serious damage to the city (destruction of buildings, infrastructure, casualties, etc.). Mudflows regularly cause serious material damage and casualties in Quito (Peltre, 1989; Feininger, 1976, 1997; Perrin et al., 1997); they are not provoked by any particular eruption, but they provide some idea of what would happen if these mudflows occurred on a larger scale.

Outside the city of Quito, several villages (Lloa, Nono and Mindo) are more threatened, due to their location on the western side of the volcano. Although they are not heavily populated (from 1500 to 2000 inhabitants), their risks are high since mudflows and fallout tephra are very destructive. Lloa could also be affected by pyroclastic flows.

The scientific context of the yellow alert in Quito

Leaving aside the first stage of alert (white alert, zero level), the yellow alert is the second stage of alert in the scale used in Quito. It is based on four stages, bearing four colours: white, yellow, orange and red (see Table 1). This scale was devised for explosive volcanoes and it is based on those established in other countries, such as the United States for Mount St-Helens, and the Philippines for the Pinatubo volcano. In the latter two cases, there is an additional stage of alert indicatig the beginning of an eruption. This stage exists in the scale of the Instituto Geofísico (IG) of Quito, but it is not mentioned in the scale disclosed to the public. In scientific terms, the yellow alert stage is reached when the volcano shows significant and increasing seismic and hydrothermal activity, in some cases with ground deformations. These signs may indicate a magma ascent followed by an eruption. However, during the yellow alert stage, the eruption is not imminent and is not expected to occur before several weeks or months.

Though the yellow alert was officially announced on 1 October 1998, the Instituto Geofísico declared the scientific alert on 29 September 1998, after phone consultation with the vulcanologists of the safety committee of the USGS (United States Geological Survey). Indeed, on that day, over 1000 volcanic earthquakes were registered, along with two phreatic explosions, and a new 50 to 70 m-wide crater was formed on the northern edge of the dome at the bottom of the caldera of the Guagua Pichincha volcano. At the time, the volcano was being closely monitored and the Instituto Geofisico was on alert due to the numerous low magnitude earthquakes registered under Quito during the months of June and July. The Guagua Pichincha volcano then began to show constant phreatic activity (thirty or so phreatic explosions between 7 August and 28 September), along with relatively high seismic activity (which abated towards the end of August and increased again at the end of September, before the high point of 29 September).

The scientific data justified the declaration of the state of alert, and its main cause for concern was the danger threatening the city of Quito.

Increasing risk awareness

Since the end of the 1970s, political representatives' awareness of risk has increased, thanks to several studies on natural risks in Quito.[1] These have led to the emergence of what may be described as a municipal risk prevention

[1] One may mention, among others, the existence of some fifteen studies, for instance studies on morphoclimatics risk (Peltre, 1989; Perrin et al., 1997), research on the perception of volcanic risk in the Cotopaxi region (D'Ercole, 1991), on the Volcano Pichincha hazard (CODIGEM, 1994;

Volcanic hazards of the Pichincha Volcano in Quito (Ecuador)

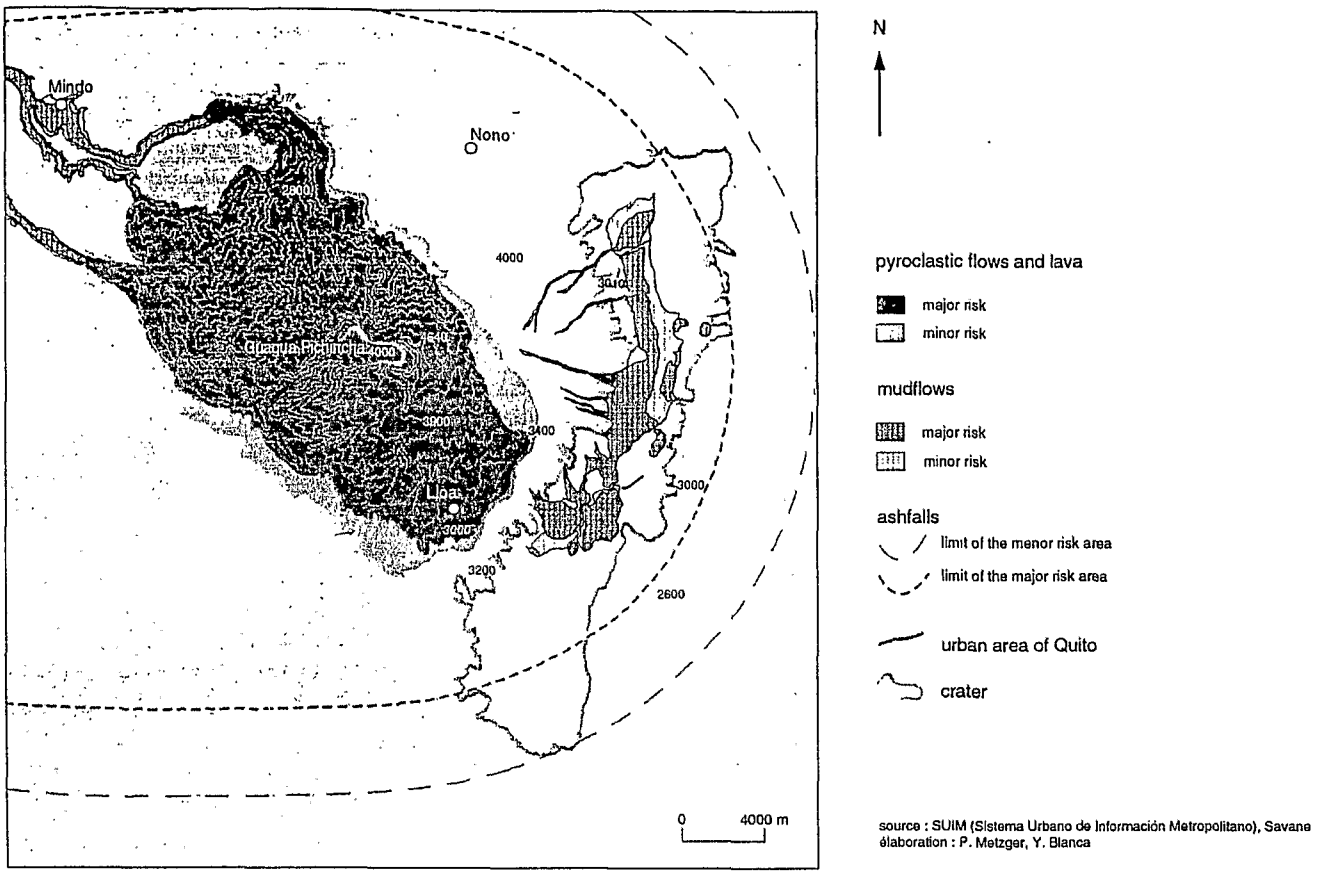

Figure 1.

policy, and to the creation of 'risk' departments in the administrative authorities in charge of city planning and the environment. For several years, the municipal authorities had been demanding that their powers be extended to include civil security and risk mitigation. Thus, in the spring of 1998, the municipality created an emergency hotline which also coordinates the action of emergency relief organizations.

1998 was an exceptional year for natural disasters in Ecuador. First, the 'El Niño phenomenon' wreaked havoc on the coast in the first months of the year (CEPAL, 1998). Then a 7.1 magnitude earthquake occurred in August, in Bahia de Caraquez, a seaside resort about 200 km away from Quito (Ceresis, 1998). Though only coastal areas were affected, the awareness of risk was heightened in Quito, for several reasons. The first was because the municipal authorities, fearing heavy rainfalls over the Sierra, decided to clean up the quebradas of the Pichincha volcano and launched an information campaign; the second was because El Niño had been a campaign issue during the presidential race between May and July; and the third was because the intense seismic activity registered under the capital during several weeks between June and August, though not actually felt by the inhabitants, gave reason to the Quito authorities to fear an earthquake of high magnitude.

The serious political risks involved

Furthermore, the increase in volcanic activity occurred at a time when political authorities were experiencing difficulties. At the local level, the Mayor Roque Sevilla's term of office had only recently begun. At the national level, trade-unions were calling for a general strike on October 1, to protest the economic austerity plan implemented by the new President, Jamil Mahuad. Although announcing the 'yellow alert' on the very same day was risky, the Mayor was determined to go ahead with the announcement. Indeed, his main concern was the question of 'how' to announce the alert, rather than its justification. Several factors explain his determination. Formerly in charge of environmental questions during President Jamil Mahuad's first term as Mayor of Quito, he had been president of the ecological Nature Foundation, deputy of the 1998 Constituent Assembly and chairman of the working commission on environmental rights. He is also a stockholder in the insurance sector, which makes him particularly sensitive to issues concerning risk. These responsibilities increase his sensitivity to matters involving natural hazards and environmental consequences.

Peltre, 1994; Mothes & Hall, 1989; EPN-MDMQ, 1998), studies on seismic risk (Chatelain et al., 1995; EPN et al., 1994) and the research carried out in the framework of the International Decade for Natural Distaster Reduction (DHA-UNDRO-USAID/OFDA).

Table 1. The warning/alert levels referred to by the Quito Geophysics Institute and the municipal authorities

Alert	Alert level	Observed phenomena	Possibility of an eruption	Interpretation	Recommended action
White	0	Basic activity	Not determined	Volcano at rest (eruption impossible)	set up monitoring instrument; develop preparation and emergency plans. Educate the population.
	1	Slight increase in seismic activity, fumaroles and temperature (fumaroles, sources)	Years Months	Hydrothermal, magma, tectonic disturbances (eruption not imminent)	Increase monitoring. Regular meetings of the technical committee, coordination between organizations in charge of monitoring. Update
Yellow	2	Moderate increase in seismic, hydrothermal, magma, tectonic activity. Possible ground deformations	Months Weeks	Possible intrusion of magma (which could possibly lead to an eruption)	Warn authorities. Daily contacts between technical committee and authorities. Public announcement of a possible emergency. Review emergency plan and intensify educational campaigns. Optimize volcano monitoring.
Orange	3	Gradual increase of former parameters. Gas emanations. Ground deformations.	Weeks Days	Confirmed magma intrusion (eruption possible)	Launching of emergency plans, increase public information campaigns, implement specific measures in the more vulnerable zones, carry out intensive monitoring and permanent technical evaluation.
Red	4	Intense activity, including tremors and/or increase of LP earthquakes and/or acceleration of ground deformations and/or growth of domes and explosions	Days Hours	Magma close to surface (probable explosive eruption)	Announce eruption. Implement measures listed in emergency plans (evacuation, etc.)

The context in which the yellow alert was announced showed that natural risk could entail political risk. Indeed, the situation challenged three principles underlying political power – responsibility, legitimacy and credibility.

First, if we look at the matter of responsibility, the political system of risk management is normally assumed at a national level, pursuant to the Law on National Security, which addresses crisis situations (Reglamento General de la Ley de Seguridad Nacional, Decreto Supremo N. 913-F of the 17th november of 1976). However the President of Ecuador, who did not wish to implicate himself because of the political situation and political risk involved agreed to transfer the management of the volcanic crisis to the municipal level, upon the request of the Mayor of Quito. The yellow alert thus triggered a transfer of power from the national level to the local level, which broke with the existing tradition of a centralized power monopoly on all questions pertaining to public security. At the same time, this transfer of responsibility put the Nacional Civil Defense in an marginal and subordinate position, whereas it had always dominated the management of every emergency situation (for example, the large landslide in La Josefina which occurred in 1993; Cadier et al., 1996)

When Jamil Mahuad was Mayor of Quito, municipal authorities had already requested that jurisdiction over these issues be decentralized. Officially, this wish was justified by the need to protect the inhabitants of Quito as efficiently as possible. Unofficially, there was serious doubt about the competence of the Nacional Civil Defense, especifically after its questionable handling of the most recent natural disasters (The Bahía de Caraquez earthquake and the El Niño phenomena). The volcanic crisis provided an opportunity to accelerate the decentralisation process in the area of risk and disaster managment. It was further facilitated by the friendship between the present Mayor of Quito and the President of the Republic, and by the fact that they are members of the same political party.

Thus, one can see that in terms of power, the municipal authorities had a lot to gain – or lose – from the situation. The next step was the gradual consolidation of responsibility at the local level. The Mayor, acting as the only official representative in charge of the volcanic crisis, thus found himself in a position of unchallenged leadership, in charge of centralizing the information – scientific and preventive – as well as coordinating municipal and non-municipal services (National Civil Defense, fire brigade, Red Cross, police force) in municipal emergency plans. The Mayor then transmitted the information to the other authorities. The fact that municipal administrations were not allowed to provide information to the media during the first two weeks shows that maintaining control over decisions regarding the nature of information to be disclosed was considered crucial by the political authorities.

At the same time, the IG was designated by the Mayor at the sole official source of scientific information, which meant that it held a monopoly over authorized knowledge and official scientific disclosures. Foreign scientists (American, Colombian, Italian, French, etc.) could only give their opinion within the framework of the IG and could speak before the media only in the presence of the director of the IG and the Mayor. As for the other local scientific institutions, (ESPE – Escuela Superior Politécnica del Ejercito, Central University, CODIGEM), their authority was hardly recognized and their opinions ceased to be listened to after four weeks. The scientific authority of CODIGEM with respect to the Pichincha volcano, highly respected until the beginning of the 1990s (DHA-UNDRO, 1993) was diminished after the monitoring instruments installed inside the volcano in 1988–1989 ceased to be maintained, and the Italian government's cooperation ended.

In this case, getting the IG to be recognized as the sole expert in a context where public institutions were generally falling under criticism also represented a difficult challenge. At the same time, that situation illustrated the political and economical risks incurred by the IG itself, which may win or lose, not only in the matter of its scientific reputation and credibitity, but its economic support as well.

Second, concerning the question of political legitimacy, Roque Sevilla became Mayor only two months before the alert, and under unusual conditions, since he succeeded Jamil Mahuad, who was elected President of the country halfway through his term of office as Mayor. Roque Sevilla's term is thus limited to two years. In addition, the Mayor was not elected by the residents but by the municipal council.

In this politically uncomfortable situation, Roque Sevilla became the first Mayor ever to coordinate the action of national institutions. According to interviews conducted by the authors with members of the National Civil Defense and the Armed Forces, these two military institutions apparently did not accept the municipal control as legitimate and considered themselves answerable only to national authorities. This attitude is also expressed by the fact that the emergency plans elaborated by both institutions are not linked to the global municipal emergency plan and represent a planned operation completely autonomous of the municipal managment. However the role of the Army and the Civil Defense remain quite important: they are in charge of organizing and executing the evacuation of the most threatened areas and providing the accomodations for the evacuated population.

They ended up accepting the Mayor's role only because the President asked them to. However, the population itself did not consider this municipal responsibility as legitimate either, since only 12% of the people surveyed trusted the Mayor to inform them about protective measures, whereas over 50% trusted the Civil Defense (see Table 2). Thus, in early October, the Mayor of Quito's sole source of legitimacy was the President's support.

The third important political stake in this crisis is the credibility of Mayor, which depends on the extent to which his decisions and powers are considered legitimate and he himself bears responsibility for them. But for his decisions to be acceptable, the Mayor must also be credible.

Table 2. Degree of trust in the various institutions involved with protective measures

Organizations mentioned	N. of times mentioned	%
Civil defense	163	50.2
Scientific institutions	42	12.9
Mayor	40	12.3
911/CES**	28	8.6
Red cross	25	7.7
None	21	6.5
Municipality	15	4.6
Foreign scientific institutions	13	4
Police/Army	14	4.3
Others	16	4.9
No opinion	9	2.8
Total	386*	

*The number is higher than the number of persons surveyed due to multiple answers.
**CES: Centro Especial de Seguimiento, the municipal crisis monitoring unit.
Source: survey of a sample of 325 persons from 9 neighbourhoods of Quito and from the village of Lloa, carried out in November 1998 by the authors.

Table 3. Popular perception of exaggerated reports. Do you think that the facts were exaggerated by political authorities? By scientists?

Exaggeration	Yes	No	No opinion	No answer	Total
Political authorities	42.2	52.9	4.3	1.5	100
Scientists	21.5	68.5	7.7	2.2	100

Source: survey of a sample of 325 persons from 9 neighbourhoods of Quito and from the village of Lloa, carried out in November 1998 by the authors.

However, Roque Sevilla is in a difficult position for two reasons. In the first place, due to constant corruption scandals involving shady political dealings since 1995–1996, the population of Ecuador distrusts political authorities.[2] Second, Sevilla alerted the population of an as yet invisible volcanic danger, just when Mahuad's government was facing major political criticism. Not only newspaper editorials and cartoons, but also the population at large was skeptical about the information. Indeed over 41% of the persons surveyed thought the Mayor was exaggerating the facts. Although people's doubts concerned mainly the volcano's activity, these doubts were very often politically motivated; this explains the differences between the answers pertaining to the degree of trust in the scientists as against that of the politicians (Table 3). The fact that the Mayor has commissioned monthly opinion polls[3] shows that he is aware of the challenge and is proceeding with caution.

[2]The Dahik and Rodrigo Verduga scandals for illegal use of public funds, and the unconstitutional impeachment of the President of the Republic, Abdala Bucaram, elected in July 1996; he was overturned by Congress in February 1997 and replaced by the Chairman of the Congress, Fabian Alarcón.

[3]The opinion polls were commissioned by the mayor and carried out by the Market Institute (Estudios de Mercado y Opinión Pública).

In terms of political responsability, Roque Sevilla balance between two roles: On the one hand, by defining himself as speaker for the IG rather than as a decision-maker, he has limited his responsibility, by taking the position that 'I speak for the volcano', or 'I speak for the scientists', (interview of 9 November 1998, and in the daily newspaper 'Hoy', 12 October 1998). In other words, in this posture, his responsibility does not exceed that of the scientists. But on the other hand, he claims the political responsibility of the Mayor over public safety and the application of the precautionary principle.[4] Indeed, in interviews and press meetings, he recognized that to be in charge of the volcanic crisis and to declare a yellow alert involves a political risk by saying 'the political experts in communication advise me against it, but it's my responsability'.

The Mayor's choice to assume control of volcano risk managment is in any case a serious political challenge. If an eruption occurs, he will be criticized about the efficiency of the emergency plan and the real level of preparedness of the city. If no eruption occurs, he will be accused of manipulating public opinion and frightening Quitos' inhabitants for political reasons. For the Mayor, bearing responsibility for security, information and administrative coordination has meant running the risk of considerable criticism; at the same time, it was an opportunity for him to demonstrate his ability to manage a crisis, and thus gain recognition and legitimacy as a result of his own competence and skills.

Thus, the volcanic crisis has turned out to be a serious challenge for the credibility of the authorities. The Mayor's power will be strengthened if he can make political discourse credible and justify the transfer of responsibility to himself. If not, his political future is in danger, at least for some period of time. In this regard scientists and political authorities both face the same difficulties, which are linked to the very nature of the yellow alert: the uncertainty factor and the time factor. The main difficulty of risk management lies in the fact that political action must be taken on the basis of probabilities, in a context of a high degree of uncertainty (UNDRO-UNESCO, 1985).

The question of the uncertainty of risk

The high level of uncertainty of volcanic risk is usually managed in two principal ways: the stages of alert and the scenarios. Lack of knowledge concerning volcanic risk leads scientists to formulate probability hypotheses and predictions expressed by the stages of alert. Thus Table 1 shows that the yellow alert stage is a 'possible eruption in years, months or weeks'. Scientifically, we are in the sphere of probability, hypothesis and prediction, without any certainty. We find the political and administrative actions clearly defined in the 'recommanded actions' in the case of a yellow alert. In the general atmosphere of uncertainty, characteristic of any volcanic risk situation, the yellow alert is a point of reference, a source of tangibles facts concerning the observed phenomena, their interpretation and their timing, for both scientists and political authorities.

As a result, during the weeks and months following the announcement of the yellow alert, all disemination of information to the public was primarily aimed at justifying the scientific and political decision to declare the yellow alert. The scientific justification was provided as a result of daily bulletins on the volcano's activity, whereas the political justification of the alert was provided by the implementation of preventive and precautionary measures. In fact, one can state that the daily publication of indicators of the volcanic activity (number and type of registred seisms, phreatic explosions and size) always results in the conclusion that it is necessary to stand by the yellow alert.

Despite their extremely uncertain nature, the scientific hypotheses implied in the yellow alert in Quito, nevertheless triggered political and administrative decisions (which in turn had political and economic consequences). Those decisions were, in summary, the decision to designate the municipal government as responsible for managing the crisis, the creation of a municipal crisis monitoring unit, the elaboration in each institution of emergency plans and the designation of responsibilities, the policy of public communication and the elaboration of evacuation plans.

The other commonly utilized method to reduce uncertainty consists of elaborating various possible scenarios of chains of events. At the same time this method limits the number of possible scenarios, it also reduces the uncertainty. In the case of Quito, the lessening of uncertainty has been anticipated by through the absence of different scenarios. Indeed, a single, general scenario was judged more efficient to prepare the administrations and the population. According to this simply outlined scenario, the expected phenomena are quite clearcut (ashes and mudflows), and the variations only pertain to the intensity of these phenomena (from 1 to 20 cm of ash, for example), and the size of the affected areas. We observed that the administrations favoured a scenario of the '1660' type (5 cm of ash), which has the advantage of being 'manageable', in the sense that it allows for efficient plans of action. The selection of a scenario that is 'manageable' rather than an equally likely but 'unmanageable' alternative is quite logical. Organizations normally pursue actions that fall within their realm of competence and avoid those that they cannot handle. But this does not guarantee optimal protection to the population. However, one may also bear in mind that an efficient policy of risk mitigation develops over time, so that what is today 'manageable' will be broadened to include an increasing number of possible scenarios.

Furthermore, even though the announcement of the yellow alert corresponded to a wish on the part of the authorities to govern openly and democratically, not everyone agreed on the legitimacy of publicizing the uncertainty of the scientists. That is showed by the fact than almost a third of the persons surveyed refuse to accept the fact that scientists may change their views. For them, this uncertainty reduces the credibility of the political and scientific authorities who are considered responsible for the resulting feelings of anxiety.

[4] Principle according to which the lack of scientific certainty should not prevent the implementation of measures to counter serious risk (cf. Galland, 1998).

Thus, the choice of a policy concerning the communication of information on uncertain phenomena is a key issue in the management of the volcanic crisis (Voight, 1990).

Turning scientific uncertainty into political action meant that the members of the Institute of Geophysics, and especially its director, had to show that they were involved in the issue not only as scientists, but also as citizens and experts. When the scientists first warned political authorities about the volcano's abnormal activity, they acted as experts, meaning they had to make a decision in a context of scientific uncertainty. This attitude may be considered to be in keeping with the principle of precaution, which is not only an ethical but also a political principle. By publicly announcing the yellow alert, the Mayor of Quito put this principle into practice, which shows that the relationship between political and scientific institutions was one of mutual trust.

Managing the release of information over time

Other than the problem of managing the uncertainty of the risk, there is also that of managing the release of information over time. The municipal authorities of Quito were concerned about keeping the population and the administrations ready for an eruption during a period of from several months to a period of years. In concrete terms, how could the population be maintained in an appropriate state of alert, as a result of permanent preventive and preparation measures, without falling into patterns of routinization, rejection, or on the other hand, potentially adopt an attitude of irrational fear?

At first, the main Quito daily paper El Comercio devoted an entire page to the activity of the volcano, the various measures and emergency plans, problems which could occur and what to do in the event of an eruption. Two months later, the quantity of information had considerably decreased, though the alert was still in force and more people were becoming convinced of the reality of the danger (see Table 4). This sudden disappearance of information caused some anxiety. A large proportion of the population (34%), especially the young people (45%), demanded more information (Table 5). According to the scientists and the political authorities, the role of the media was to provide clear and simple messages while admitting the uncertainty over the interpretation of the volcano's activity as well as the anticipated phenomena. At the same time, their role was to determine the proper dosage of information which could be accepted by the population over time.

In addition, it should be noted that the tourism sector was pressuring authorities to shorten the duration of the alert, since the prolonged alert was bad for business. Lastly, from a strictly institutional point of view, if a situation of crisis continues for a long period of time, there is a greater chance that there will be staff changes occurring in the affected institutions, because of normal career advancement and changes in personnel and as a result of changes in elected political leaders and their appointees. This could be detrimental to the efficiency of the preventative and monitoring programmes and could render communications difficult because of the lack of information on the part of new staff.

Table 4. Changes in public perception of danger

	Yes	No	No opinion	Total
Was there any real danger at the time the yellow alert was announced?	53.5	61.8	0	100
Is the situation still dangerous (5–6 weeks later)?	68	24.3	7.7	100

Source: survey of a sample of 325 persons from 9 neighbourhoods of Quito and from the village of Lloa, carried out in November 1998 by the authors.

Maintaining a general atmosphere of trust over a long period of time is a major difficulty in the management of a long volcanic crisis. In addition, the decision to provide information on volcanic risk despite the uncertainty of this information represents a political challenge for the democratic management of major risks.

A beneficial period

The political and historical background of the crisis presented in this paper shows that risk management can represent an opportunity and a challenge for authorities seeking to assert their legitimacy. In fact, the announcement of the yellow alert in Quito in October 1998 not only responded to the increasing volcanic activity, but was above all, the result of the political position taken by local political authorities together with the positions of experts and citizens taken by the scientists of the IG. Both were consistent with the precautionary principle. But this principle is not the only explanation. Numerous logics concurred to this situation, first of them the political considerations. Analysing the making-decision process and the political implications of the announcement of the yellow alert, one can appreciate the difficulty in managing volcanic risk, with its inherent uncertainties, communications problems and the time factor, difficulties felt not only for the local authorities but for the scientific experts as well.

A consequence of the early announcement of yellow alert is that the population and the administration were given more time to prepare for the event. Thus, what may seem a question of mere chance – the fact that four months after the alert announcement (as of the time this was written), the volcano has not yet erupted, – can also be seen as a deliberate crisis management strategy, intending to allow more time for preparation. In other words, what could have been initially interpreted as imperfect management of uncertain risks over time could also be considered in the opposite light, as a period during which the population and administrations can learn to confront and deal with a risk which, until then, had been basically ignored. In the same way, the yellow alert event has led to increased research and monitoring of the volcano, which in turn has made it possible for scientists to improve their knowledge of the volcano's behaviour and, as a result, their predictions.

Table 5. Opinions about the information received, by age group

Age opinion	No answer	Under 25	25–35	35–50	50–65	Over 65	Total
No answer	0	0	0	1,2	0	0	0,3
Enough information	33,3	44,9	46,4	56,6	47,1	73,3	49,8
Not enough information	66,7	44,9	40,5	31,3	21,6	6,7	35,1
Too much information	0	10,1	13,1	10,8	29,4	20	14,5
No opinion	0	0	0	0	2,0	0	0,3
Total	100	100	100	100	100	100	100

Source: survey of a sample of 325 persons from 9 neighbourhoods of Quito and from the village of Lloa, carried out in November 1998 by the authors.

It should be noted that the institutionalization of major risk prevention and emergency situation management has served to strengthen the municipal authorities from both a political and a technical point of view; new political and administrative structures were created, traditional and new systems of communication boosted, inter-institutional dialogue developed and numerous services improved. At the same time, the yellow alert made it possible to determine the weak points of the volcanic risk prevention and crisis management systems in Quito.

Despite the unavoidable problems and difficulties carried out by the volcanic crisis, Quito has benefitted from the situation and reduced its vulnerability by improving its level of preparedness and by its implementation of a risk prevention policy. At the same time, Quito is enhancing the responsibility, credibility and legitimacy of its political and scientifical authorities. Thus political authorities, scientists, and the population as a whole can all benefit from the situation created by the announcment of the yellow alert.

Close to one year has elapsed since the volcano as declared in yellow alert status, when it changed from a phreatic to a magmatic activity. On 29 September 1999, the first magmato-phreatic explosion occurred, forming in the process a lava dome inside the caldera. Since then, several domes have been formed and destroyed causing lahars and small pyroclastic flows on the western slope of the volcano leading towards the Cristal River. Several explosions, notably the one on 5 October 1999, resulted in ash fall over the Ecuadorian capital of Quito.

The article was written during the weeks following the declaration of the yellow alert on October 1998 and illustrated several political challenges with respect to the management of the volcanic crisis and its associated problems, specifically the inherent uncertainty and the prolonged duration of the crisis. What is the situation one year later given the current state of volcanic activity? To answer this question, important fieldwork is required, work that has just begun as these lines are written. Then, it is difficult to draw definite conclusions based on firm arguments. However, we can see some general trends that match what it was observed in 1998. The political challenges of the crisis continue to be important and this is illustrated by the persistent efforts of the Mayor of Quito to strengthen his credibility and legitimacy. The mayor always tried to keep pristine the cooperative relationship between the Geophysical Institute and the Municipality regarding the crisis follow-up, despite criticisms of its management and centralized nature. He also got personally involved in volcano observation operations during the critical period and was in personal communication with the public during the ash falls and the alert changes. Finally, the increased volcanic activity itself strengthened the mayor's credibility since its predicted probability became a reality when the volcanic mushrooms were visible to everyone and Quito was subject to ash falls.

This situation facilitated the management of the crisis. Visible volcanic activity resulted in a greater degree of participation by the population, even though over time it also creates a degree of habit that may in turn work against an effective mobilization. On the other hand, even though there was a marked change in the nature of the volcanic activity, the eruptive process did not accelerate in such a manner as to suddenly endanger the capital city of Quito. The volcanic process is still permitting the population time to improve its readiness. But uncertainty is still present and very little has actually changed from one year ago besides achieving a greater degree of public credibility and an increased state of readiness.

What has probably changed the most since the 1998 study is the crisis management. One of our conclusions underscored the yellow alert state as a reference point both politically and scientifically, which is no longer the case. Indeed, since October 1999 and the first occurrences of ash fall over Quito, we witnessed a gradual change from a system of alerts based on scientific criteria to one based on the expected consequences. This leads to a differentiated spatial management of the crisis (between the areas with higher risk like Lloa and the rest of the metropolitan area) resulting from a practical adaptation based on the experiences drawn from the ash falls.

However, this adaptation process has not resulted in a clear restructuring of the system of alerts, which leads to a degree of improvisation in the implementation of contingency plans and to a feeling of confusion in the population. The way the alerts are managed reflects the difficulty the authorities are experiencing in assimilating the changes in

volcanic activity, even though these changes are slow, which in turn reduces political credibility during the volcanic crisis management.

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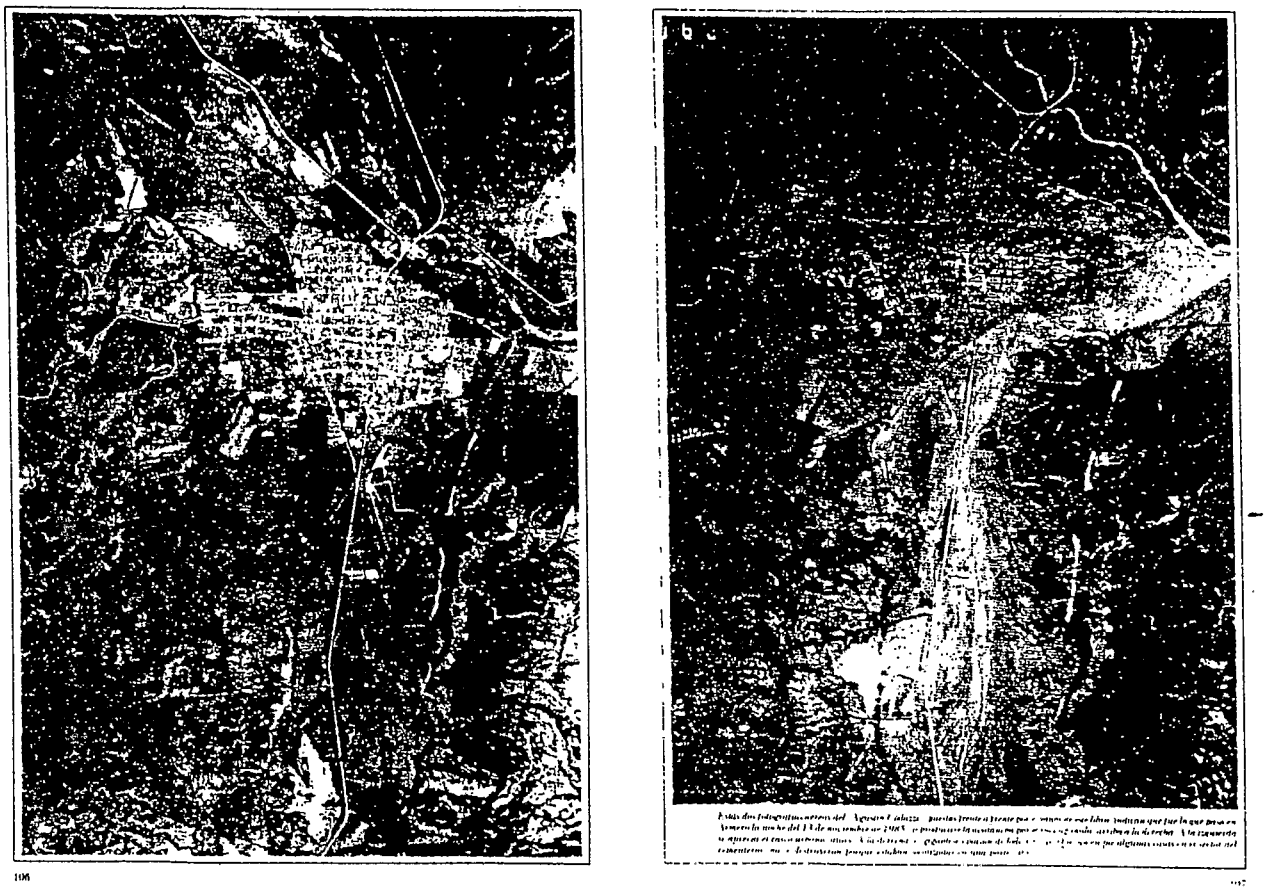

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