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Scientific Communication in Volcanic Risk Assessment and Management: Perspectives on global practices

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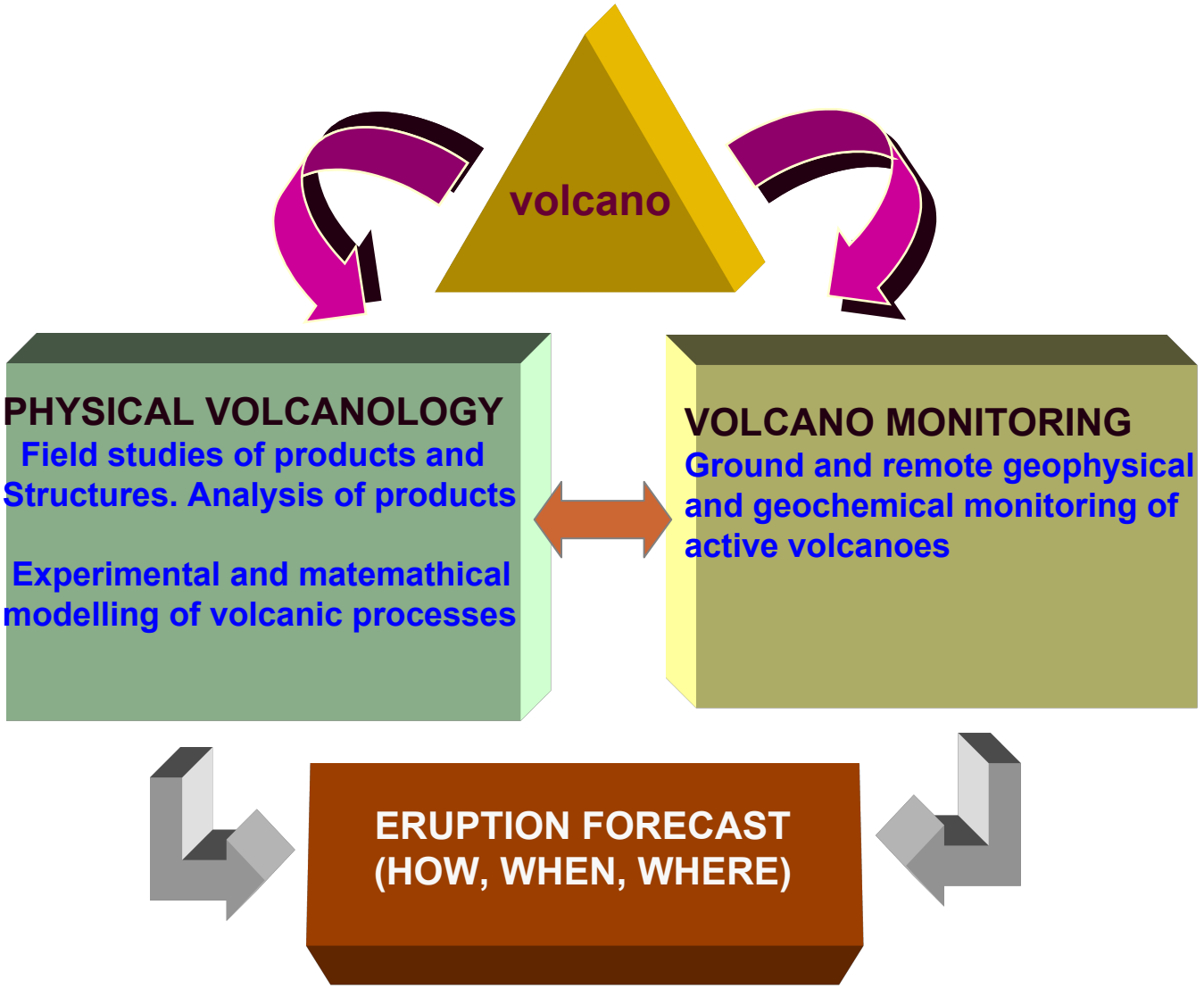
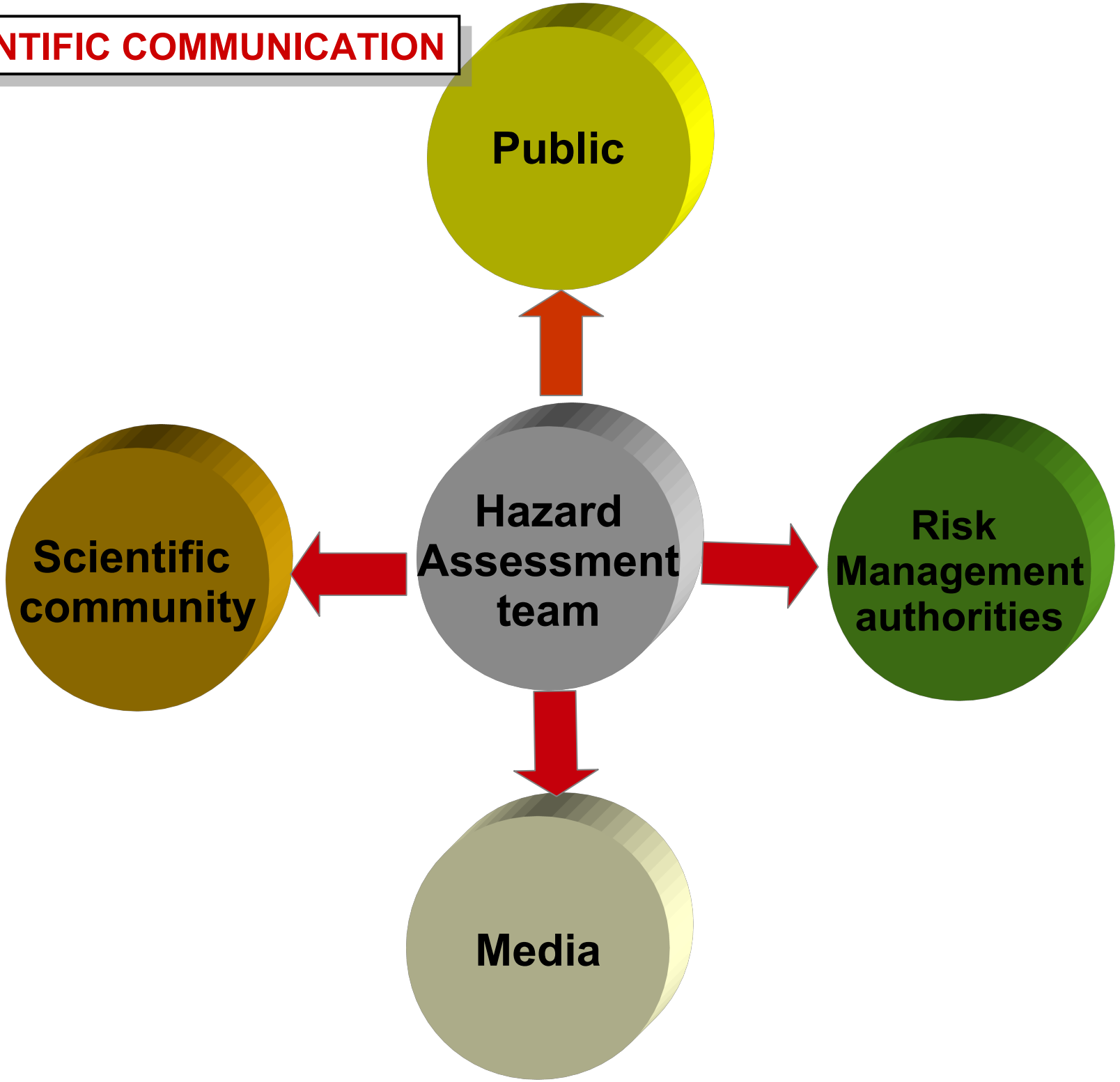
FORECASTING VOLCANIC ERUPTIONS



SCIENTIFIC COMMUNICATION



COMMUNICATION STRATEGIES

- Why to communicate?

- When to communicate?

- What to communicate? Communicating uncertainty in volcano forecasting

- How to communicate? Ways to communicate

WHY TO COMMUNICATE

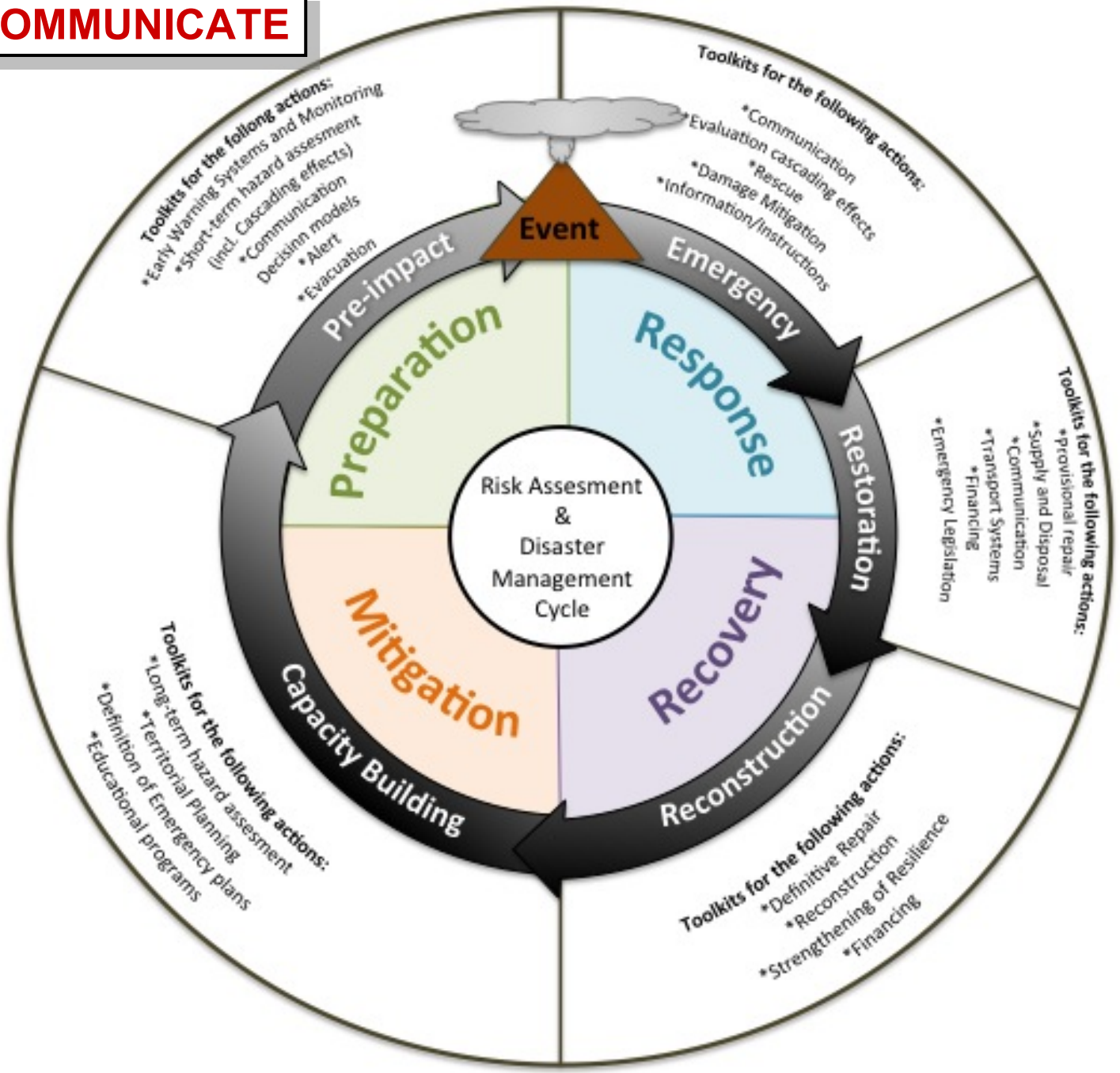
The best way to ensure effective risk reduction is to anticipate any potential impact, and this is better achieved when there is a good knowledge of the scientific work at a general level. Educated (informed) societies are less vulnerable to risk

It is necessary to translate the scientific understanding of volcanic activity into a series of clearly explained scenarios that are accessible to the decision-making authorities. Also, direct interaction between volcanologists and the general public should be common both during times of quiescence and activity.

Information coming directly from the scientific community has a special influence on risk perception and on the confidence that people put in scientific information.

The main goal of volcano forecasting is to respond to how, where, and when an eruption will be. Making predictions on what the future behaviour of a volcano is going to be follows basically the same reasoning as in other natural phenomena (storms, landslides, earthquakes, tsunamis, etc.), but does not necessarily have the same level of understanding by the population and decision-makers.

WHEN TO COMMUNICATE



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Hazard Communication Phase

Long Term	Medium Term	Short Term	Emergency	Recovery
-emphasis on trust building -develop protocols -irregular hazard communication	**-emphasis on hazard education;** **regular communication but not daily**	-daily communication and updates as required	-prioritize communication with disaster management authorities. -daily summaries and updates as events dictate.	-emphasis on assessing protocols; -prioritize communication with public.

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WHAT TO COMMUNICATE

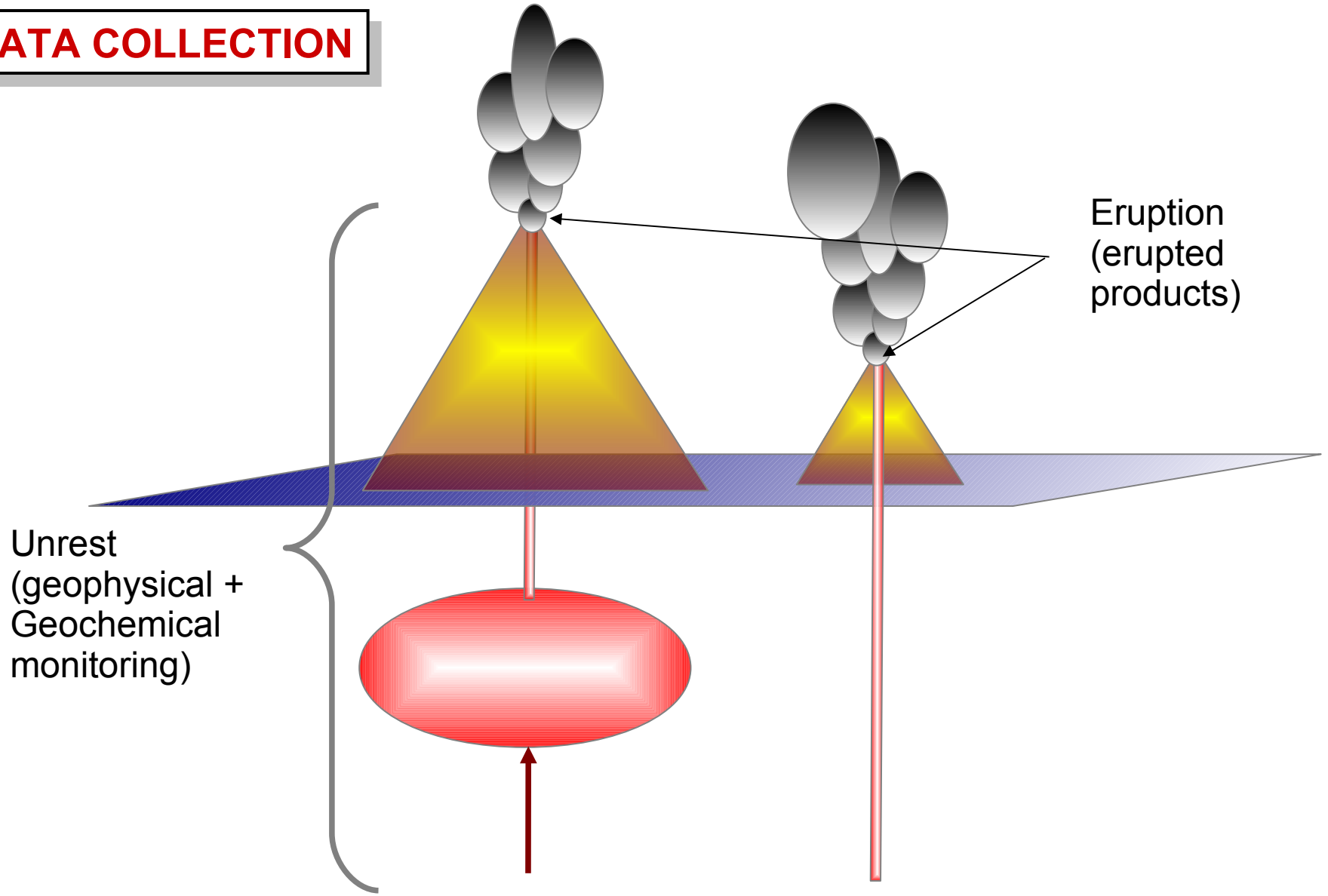
Volcano forecasting is a challenging issue. This is in part due to the lack of experience in making predictions on the behaviour of volcanoes (compared to forecasting in other natural hazards).

Modern volcanology is a recent science and compared with meteorologists, who have been using the same methods (with every day more sophisticated techniques) for several centuries, volcanologists are still in an early stage of volcanoes prediction and, more importantly, of understanding eruption precursors.

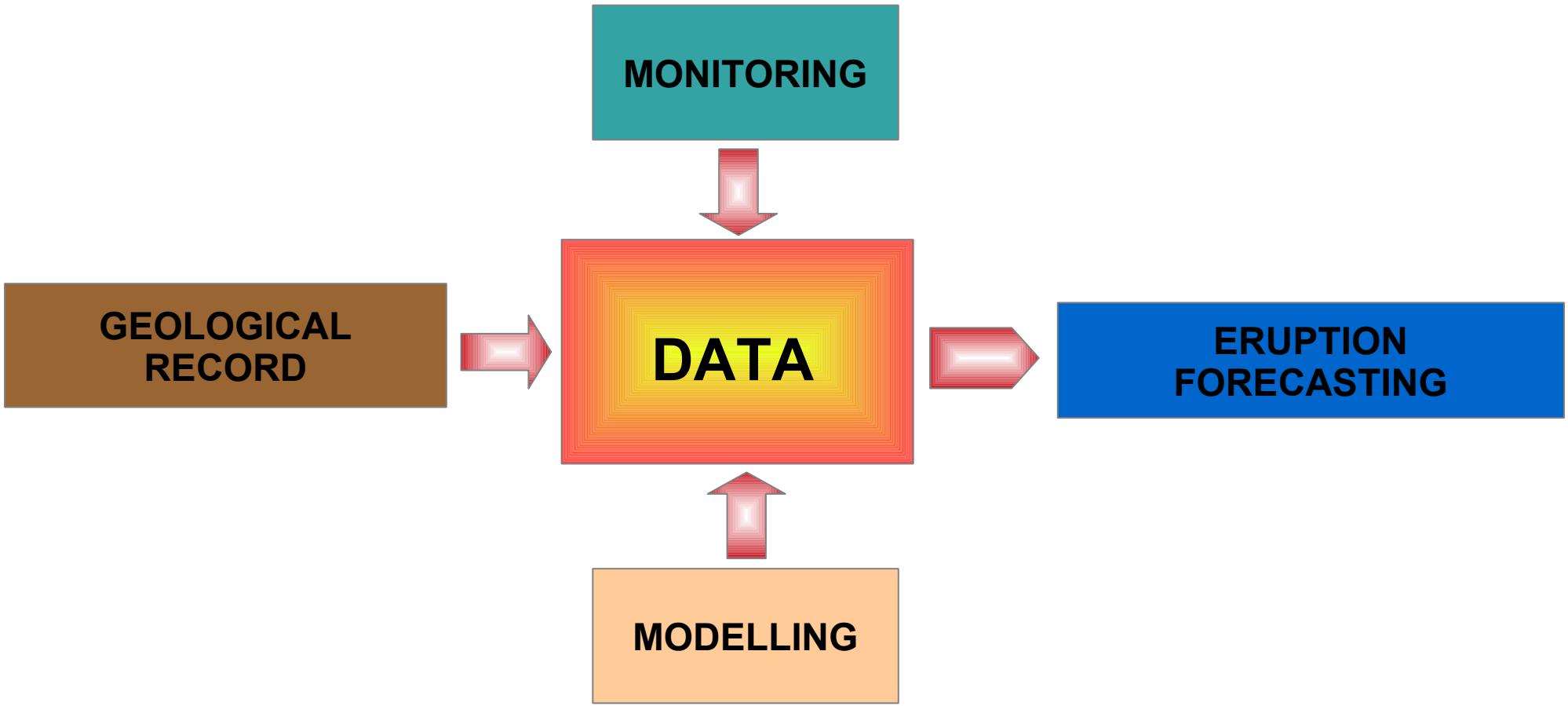
All volcanoes behave in a different way, so a universal probabilistic model to understand behaviour of volcanoes does not exist. Each volcano has its own particularities depending on magma composition and physics, rock rheology, stress field, geodynamic environment, local geology, etc., which make them unique, so that what is indicative in one volcano may be not relevant in another.

All this makes difficult to quantify and communicate this high degree of uncertainty to the population and decision makers.

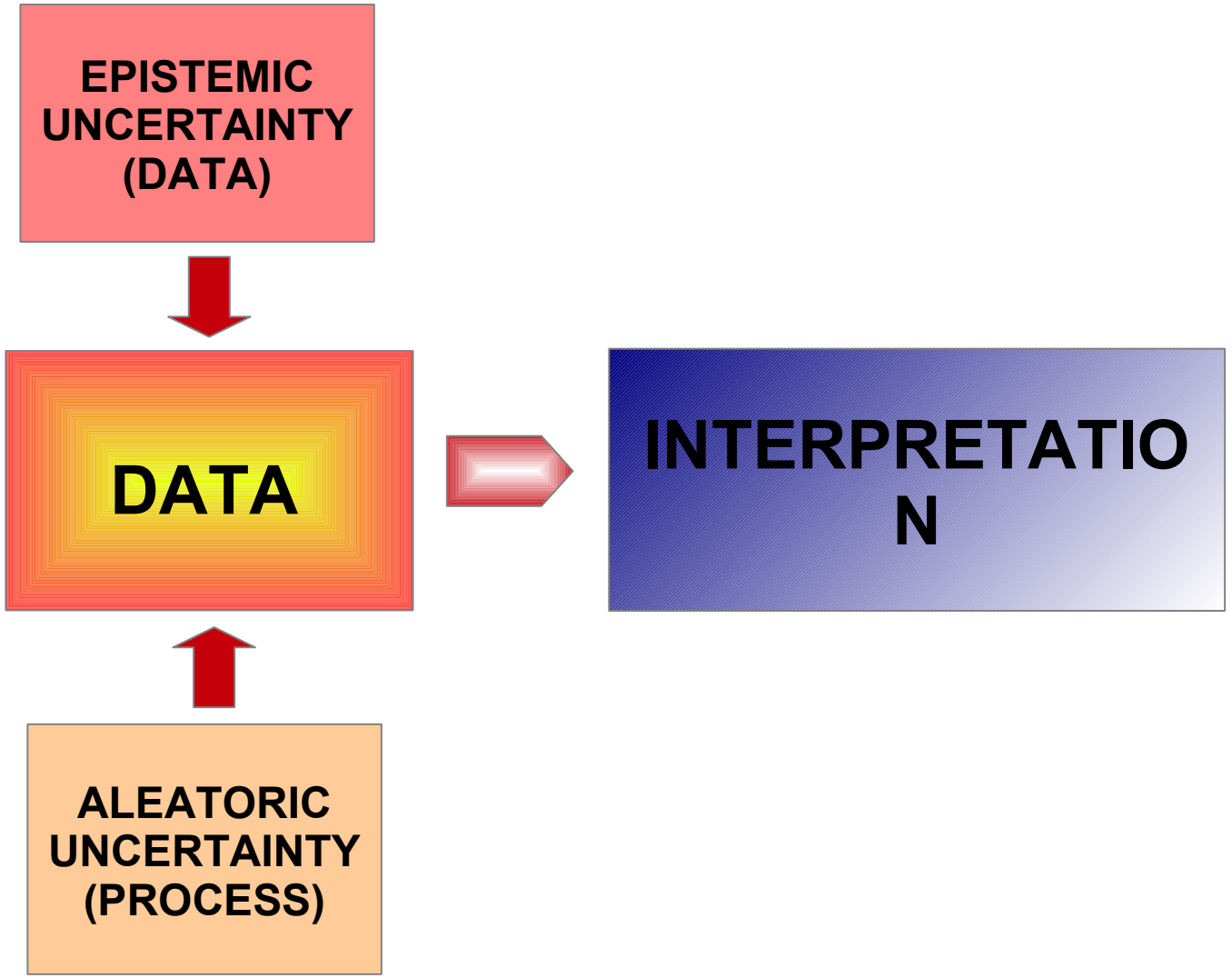
DATA COLLECTION



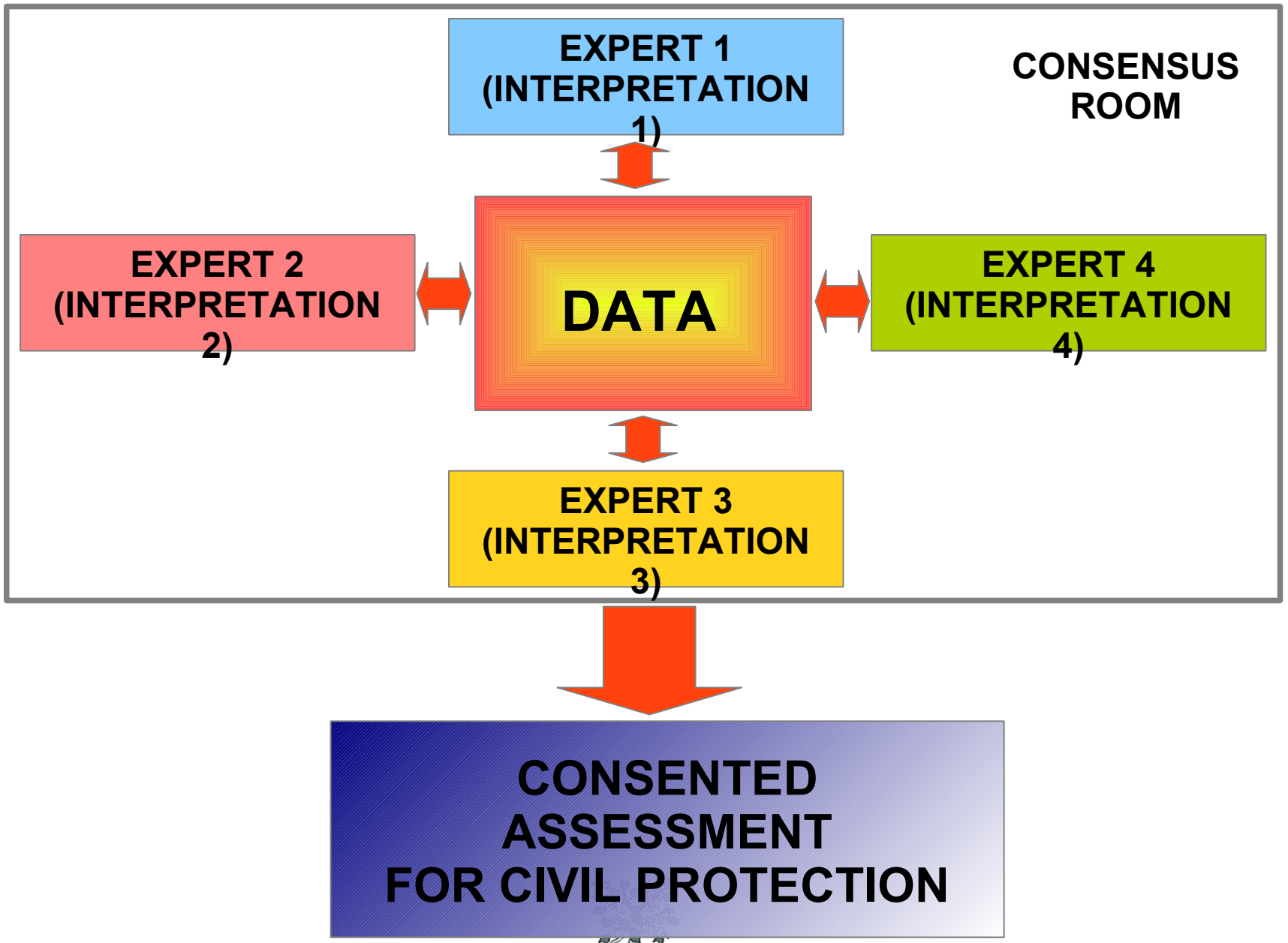
DATA SOURCES



DATA RELIABILITY (UNCERTAINTY)



DATA INTERPRETATION



UNCERTAINTY SOURCES

HOW?:

Past events (chronostratigraphy, volcanic stratigraphy, physical volcanology)

Volcanic susceptibility (structural controls of volcanic activity)

WHEN?:

Recurrence (past events + monitoring)

Precursors (precursors -monitoring-: seismicity, ground deformation, gases, …)

WHERE?:

Volcanic susceptibility (geological data – long term assessment)

Precursors (precursors -monitoring-: seismicity, ground deformation, gases, …)

COMMUNICATING VOLCANO FORECASTING

The best way to present volcano forecasting is by providing probabilities of occurrence

Probability is the quantification of uncertainty

To quantify uncertainty using statistics there are three main disciplines statisticians rely on, data analysis, probability and statistical inference.

Making predictions on the future behaviour of a volcano basically follows the same reasoning that is behind weather forecast (analysis of past data, monitoring of current situation and identification of possible scenarios), but it is not so easily understood by the population and decision makers. This is in part due to the limitations of volcanologists to understand probability estimates and communicate their meaning in simple language, and also because population and decision-makers are not as used to listening volcano forecasts as they are with weather forecasts.

The uncertainty that accompanies the identification and interpretation of eruption precursors, derives from the unpredictably of the volcano as a natural system (aleatory uncertainties) and from our lack of knowledge on the behaviour of the system (epistemic uncertainties). These uncertainties can be redefined as shallow or deep (Cox, 2012; Stein and Stein, 2013a) depending on the eruption frequency of the volcano, in the sense that highly active volcanoes with high eruption frequencies can be more easily predicted (i.e. they are reasonably well known) than those characterised by low eruption frequencies, respectively.

HOW TO COMMUNICATE

There are different ways in which probabilities (and uncertainties) can be described. These include words, numbers, or graphics.

The use of words to explain probabilities pursues to offer a language that appeals to people's intuition and emotions. However, it usually lacks of precision as it tends to introduce significant ambiguity by the use of non-precise words such us “probable”, “likely”, “doubtful”, etc.

Using mathematic expressions is likely the right way to describe probabilities but it may fail when the audience has a low numeracy.

In the last years it has been increasingly common the use of graphics to represent probabilities in natural hazards. The advantage of communicating uncertainties (or probabilities) visually is that we are everyday better prepared and trained to use and understand infographics, and a graphic can be adapted to the aims of the communicator, stressing the importance of the context of the communication exercise and the needs and capabilities of the audience.

Volcanologist should try to adapt these modern methodologies to their needs, in order to make volcano forecast and its intrinsic uncertainty clear enough to any potential receptor of this information.