# Meeting of the
# Group of Experts on Forest Fires in
# Latin America and the Caribbean
# Workshop on the use of satellite remote sensing for wildfire monitoring and wildfire information systems

## MODERATION AND SPEAKERS

The second day of the dialogue focused on the regional and international organisation perspective on "Using satellite remote sensing for wildfire monitoring and information systems". Once again, Dr Jesús San-Miguel-Ayanz, leader of the European Forest Fire Information System and Global Wildfire Information System Team of the Joint Research Centre (JRC) led the initiative with Mrs Monica Mota moderating the discussions of day 2.

- Mr Sergio Rico, Director of the National Emergency System Uruguay in the **Presidency of the Republic of Uruguay**
- Dr Jesús San-Miguel, Joint Research Center, European Commission, leader of the Group of Experts on Forest Fires in Latin America and the Caribbean, **European Union**
- Mr Raul Salazar, Chief of the United Nations Office for Disaster Risk Reduction (UNDRR)
- Mr Isaac Ocampo, ARO data science consultant specialist, Amazon Cooperation Treaty Organisation (ACTO), **Brazil**
- Mr Fabiano Morelli**,** Earth Observation Coordination, National Institute for Space Research (INPE), **Brazil**
- Mr Rodrigo Fleytas, Head of department remote sensing & geographic information systems, GEOLab, **Paraguay**
- Mr Dante A. Guglielmin, Head of Chair, Forest Protection, Ministry of Environment and Sustainable Development, **Argentina**
- Mrs Natalia Zarko, Ministry of Environment and Sustainable Development, **Argentina**
- Mr Eliot Castro Menan – Ministry of Environment and Water, **Bolivia**
- Mrs Talita Oliveira Tarlei de Freitas, Brazilian Institute of the Environment and Natural Resources, Prevfogo (IBAMA), **Brazil**
- Mr Luis Pacheco Motta**,** Brazilian Institute of the Environment and Natural Resources, Prevfogo (IBAMA), **Brazil**
- Mr Jorge Ellecer Arias Rincón, Amazon Institute for Scientific Research**, Colombia,**
- Mr Guillermo Flores, National Institute of Meteorology and Hydrology (INAHMI), **Ecuador**
- Mrs Romina Liza Contreras, National Forest and Wildlife Service (SERFOR), **Peru**
- Mrs Sheila Gamarra, National Forest and Wildlife Service (SERFOR), **Peru**
- Mr Matías Ocampos, National Emergency System (SINAE), **Uruguay**
- Mr Gabriel Caviccioli, National Emergency System (SINAE), **Uruguay**

## AGENDA

- **SESSION I:** Opening Remarks
  - Opening remarks by the leader of the European Forest Fire Information System
  - Opening remarks by
  - Main points and summary of the first day
- **SESSION II:** Early warning systems in regional/multinational use systems:
  - Perspective Amazon Cooperation Treaty Organisation (ACTO)

  - Perspective Amazon Cooperation GWIS
- SESSION III: Early warning systems in local/national use systems:
  - Perspective Paraguay
  - Perspective Argentina
  - Perspective Bolivia
  - Perspective Brazil
  - Perspective Colombia
  - Perspective Ecuador
  - Perspective Peru
  - Perspective Uruguay
- **SESSION IV**: Conclusion and Question & Answer session

## SESSION I: OPENING REMARKS

The day commenced with the Director of the National Emergency System Uruguay in the Presidency of the Republic of Uruguay, Mr Sergio Rico, welcoming the participants and addressing the gathering. This was followed by the opening remarks of the Chief of the United Nations Office for Disaster Risk Reduction to Latin America and the Caribbean, Mr Raul Salazar.

The UN representative thanked the organisers and started his presentation by noting the importance of integrating scientific knowledge and technology and its impact on wildfire management. According to the speaker, wildfires strongly influenced the south of US and Canadian territory, where one witnessed the effect and the increasing frequency of occurrence. Hence, the situation was worse at the regional headquarters. Mr. Raul explained that, as a result, the emphasis on integrated, comprehensive approaches to wildfire management should not only integrate science, technology, and management but also embrace a broader perspective and consider the impact of socioeconomic development factors. While noting the integrated forest fire group's interest and approach to establishing programs and designating priority areas at the national and regional levels, he emphasised the need for a comprehensive and integrated strategy.

### MAIN POINTS AND SUMMARY OF FIRST DAY: DR JESUS SAN-MIGUEL

Dr San-Miguel opened the day's programme by summarising the previous day. He noted the two critical areas discussed regarding prevention and integrated fire management and outlined the first point of discussion related to integrated fire management presented by FAO, which was based on the Myers 2008 model and incorporated the 5 Rs. Next, he outlined ACTO's presentation that showed that eight countries are already involved in integrated fire management and the Memorandum of Understanding in place as a group whilst respecting the country's diversity in their national approach.

Moving on to the country's perspectives, he noted the consensus on integrated fire management related to leadership, saying that most countries have aligned with elements of both FAO and ACTO. He, however, pointed out that the decrees have varying levels of limitation and laws and stressed the variances in countries such as Peru, Colombia, Ecuador, and Brazil. In clarifying the use of fire in Brazil, Dr San-Miguel noted that fire is not forbidden but controlled and used for research purposes. Another factor raised was the interconnectivity between fire and the indigenous communities' cultural practices. Dr San-Miguel next noted that the forthcoming ACTO summit would take place in six months and clarified the group's collective impact within the country, with a potential focus on integrated fire management with fire as a tool. Other proposed areas were related to a meeting on disaster risk reduction, prevention, and mitigation. The presenter then outlined the advancements in prevention information systems, advanced data on data risk hotspots, fixed camera imaging, and prevention extension. As a positive feature, another aspect highlighted was process integration and integrated fire management.

In conclusion, Dr San-Miguel affirmed that the presentations had generated significant feedback and added that participants should send any additional comments or suggestions to the project team. He emphasised the need for integrated fire prevention and management measures. Dr San-Miguel, therefore, proposed that the group draft a document comparing the group presentations and the fire conditions, such as the insufficient range restoration and it led to a brief discussion among the delegates.

- One of the delegates, in response, stated that to prevent forest fires and to complement the integrated model service, the fire strategy should incorporate restoration. It is especially essential considering the global decade of ghost extraction and the need to consider how to restore stop by preventing forest fires.
- Another delegate was interested in researching integrated fire management, investigating the causes of fires related to environmental change drivers, and economic and social aspects such as poverty marginalisation that underlie tropical fires in most fires.
- Another delegate sought clarity on whether the meeting will adopt a global working concept on integrated fire based on the MOU or alternately retain the varying working concepts. Dr San-Miguel, in response, raised the prospect that countries which sign the ACTO agreement, on the definition, should be able to modify it after signing. In addition, he noted that signing the MOU does not necessitate a policy change but rather the exploration of options.
- In conclusion, the concurrence was a regional concept on integrated fire management followed by adaptation of country-specific contexts leading to appropriate action. The proposed text read: "The group of specialists from Latin America and the Caribbean agree with the general concept of integrated fire management, and each country may nationally implement certain policies or others that are unique to that country."

## SESSION II: EARLY WARNING SYSTEMS IN USE REGIONAL & MULTINATIONAL

### PERSPECTIVE REGIONAL: MR ISAAC OCAMPO

Mr Ocampo, commenced his presentation by thanking Uruguay and the organisers for their hospitality. He, at the onset, pointed out the unique identity of the Amazon observatory and the innovative initiative related to biomes, where ACTO coordinates with the region to gain a regional perspective. According to the presenter, ACTO has applied the Amazon regional observatory's goals to each country's patterns to compile regional reports since 2021. As such, Symmetry contains integrated, automatic, and thematic modules encompassing status modules, water resources, indigenous peoples, and other forests. He noted that ACTO has yet to launch the integrated module promoting services; however, the interest was to present the related success witnessed thus far.

He then explained two main methods following the previous day's presentation. The prevention alert includes integrated fire control, monitoring, flow, and damage restoration extension assessment. Thus, ACTO requires a sound institutional framework, civil society engagement, science & technology, and tracking global changes. He further observed the critical nature of technology and services in improving data science. Another key factor was that ACTO evaluated tester encounters and did not limit data from global institutions, which was the underlying reason for the positive rating.

Next, he noted that as outlined by ACTO the previous day, the organisation cannot offer international, national, or MOU-proposed services on the legal framework. Furthermore, ACTO monitored meteorology, deforestation, and replanting and proposed starting a climate change research platform where the use of fire will be part of the different technologies promoted.

He also explained that the organisation offered a fascinating fire monitoring service, updated daily every three to four hours. The Brazilian service includes active buyers in protected areas and indigenous lands, and it thus allows innovation of specific events in the Amazon region. Further, he said many have recognised that working with hotspots differs from assessing fire event size, dimension, and magnitude.

Mr Ocampo next presented a short video clip which depicted the primary fire-tracking method. He explained that the study was ongoing as validating the process ensures accuracy. He additionally remarked that the primary tracking method fights fires in Brazil and work continues to create accurate projections. Therefore, ACTO monitors the locations daily and confirms that the database is valuable for climate change research. He then explained that the forestry module viewer integrates hotspots, fire protection data, and the ACTO context on the political map of Amazon basin regions and provinces. According to Mr Ocampo, the organisation endeavours to aid processes and authorities in various nations in fighting flames and further aims to disseminate its efforts on a global scale. He remarked that it was unthinkable without a more comprehensive strategy for the Amazon region and emphasised that ACTO expects to prevent bordering flaws, leading to the most effective restoration efforts. In conclusion, he elaborated on two crucial initiatives associated with the Brazilian monitoring room and the water resources programme.

## PERSPECTIVE REGIONAL/MULTINATIONAL: MR FABIANO MORELLI

Mr Morelli commenced his presentation by outlining that the interpretation of an early warning system takes response time into account most heavily in Brazil. He noted that it was crucial to differentiate the systems and explained that Brazil has a tracking system, not an alerting system, which supports and generates specific information over time based on temporal and spatial responses. Therefore, the tasks required different responses for firefighters, park rangers, and sugarcane field workers for deforestation and reforestation purposes. He clarified that rapid systems and data would create long-term and short-term responses. Mr Morellis further explained that daily meetings take place to decide the day and following day's progress, and other long-term trends are also considered. More importantly, INPE then uses the expertise and knowledge to create policies or future investments in contracts related to firefighter brigades or other units' placement.

Mr Morelli next clarified that the INPE webpage displays its services and products rely on active fire spots and burnt areas to identify fire events, and fire risks and new data-based systems. Furthermore, according to Mr Morelli, INPE checks GOES data two or three times a day since it produces statistics every 10 minutes, and the institution then coordinates the information to CIMAN. He said that Prevfogo/IBAMA was responsible for all federal activities in Brazil and added that CIMAN now integrates material virtually and seeks satellite, ground, and other decision-making data through the SISFogo system, which incorporates and uses ground-level data. According to Mr Morelli, INPE creates data and daily reports, then relayed to various officers, including the Presidency of the Republic and the weekly civil office briefing meeting. He then clarified that analytical studies and geological data help INPE to interpret average rainfall and temperature and presented an example of one such case related to a particular month, which led to CIMAN intervention and regular distribution and statistics for analysis. He also noted that since it lies within the distribution, there are average values that are very low or very high where the outliers run. He explained that extreme weather, temperatures, and risks are higher at level one. Additionally, he noted that the monitoring system alerts INPE where to look for changes, enabling it to make decisions in the most critical areas. INPE additionally has a web interface with information about fires, smoke, and fire risk in South America, which analyses data and extracts tables. Further, a second system, related to the statistics system, provides users with the knowledge to make long-term decisions.

Next, addressing the linkage between vegetation vulnerability and fire, Mr Morelli outlined that Brazil uses a data-driven environmental analysis method. The methodology used precipitation variables, station map temperature, humidity, altitude, latitude, and other anthropic factors, and the process shows what occurs in Brazil. He further noted that fire risk persists year-round. Finally, another software programme and platform presented was TerraMA2, which monitors, analyses, and warns about streaming events. The relevant TerraMA2 platform informs decisions in several areas, including satellites, work, and everything integrated. Thus, the platform lets INPE organise projects by theme (fires, floods, landslides) or data access level and a project that uses public data will gather, collate, and display immediately per software. In addition, the users on mobile or email obtain information through a rule-based system which allows searching according to various protocols data sources within or outside this integrated database. He also noted that it further allows viewing data graphically and conducting Python analysis. In closing, he expressed that the INPE information systems can assist Brazilian colleagues by providing fire-related information.

### PERSPECTIVE REGIONAL/MULTINATIONAL: DR JÉSUS SAN-MIGUEL

Dr San-Miguel next presented the Global Wildfire Information System (GWIS). In his presentation, he described GWIS as the early warning system that predicts Europe's fire risk index. He displayed the GWIS system, which presented several sections with different years and provided population information. He explained the physical layers, which allowed for inclusion in the display and clarified that an element allows one to predict the fire risk. The GWIS has several geological and hotspot models used to contain the fires. Concerning the fire hazard risk in the EU, Dr San-Miguel said that there are three meteorological prediction models—namely, the European Centre for medium-range weather forecasts, Meteo France, and NASA Goes-5.

He noted that the European Centre for medium-range weather forecasts was relevant globally and collated information from various European Meteorological institutions. It is a robust system with global potential used by many, and it is the base used by GWIS. The system has a range of 8 KMs for fire hazard risk detection.

Dr San-Miguel next outlined the use of Meteo France. It is the first model, with a range of 10 km. The use of the system commenced historically with the European EFIS system to study data. It has quite a large base of historical data and records and operates with GWIS. The third model NASA Goes, the GWIS system, is supported by it, and presently there are three ongoing projects connected to the Fire Risk hazard. Apart from it, NASA Goes has a meteorological model supporting crucial information.

As part of the GWIS Hazard/Danger Indices, GWIS includes the Fire Weather Index, Keetch and Byram's Drought index, McArthur Forest fire danger index, and the National Fire Danger rating system. There is an extensive bibliography regarding the Fire Weather Index. Dr San-Miguel explained that Europe had worked on this concerning hazard indices for over 25 years. Additionally, the details are calculated based on the other national systems. After more than six years of work, the GWIS compiled information and developed the Fire Weather Index. This system is used as it is the world's most popular rating system, and one can see how it works in different countries and assess its usefulness. Another factor was that GWIS now estimates fuel oil based on high temperature, low relative humidity, and precipitation.

Furthermore, GWIS now provides a better idea of the primary condition in the upcoming instance of anomaly detection, which is a touring thermal anomaly and rain for the entire month. However, if GWIS combine rotation and temperature, the conditions are extreme. Finally, Dr San-Miguel noted that the seasonal forecast does not include thermal exploitation anomalies, explaining that they were noted daily and stated that values for every day of the week of the fire.

## SESSION III: EARLY WARNING SYSTEMS IN USE LOCAL AND NATIONAL

### COUNTRY PERSPECTIVE PARAGUAY: MR RODRIGO FLEYTAS

Mr Fleytas from Paraguay presented the GEOLab project that created early warning systems for departments in the country as part of the UNDRR's resilience tech in 2022. He noted it was an early warning system prototype and the collaborators worked on improving it with the network of the disaster risk reduction programme at NASA, UN-SPIDER, and UNDRR.

Initially, he described how GEOLab developed the prototype, which included creating systems and monitoring procedures, forecasts and hazard prediction, disaster risk reduction, and evaluation. According to Mr Fleytas, the project initially began with two forums, one of which enabled the community of the population that was used as the first community to pilot the prototype to set the location of their residence and indicate whether a fire event occurred. As a result, the agency updated the interface immediately and the platform for administrators.

He next outlined the segment forum, allowing viewers to choose whether they can see the field, indicating whether the fire event is currently active. Further, he explained that it could indicate precisely where the event occurs. In addition, they can show the polygon or perimeter of the location where the event takes place. He also presented an illustration of community involvement. Mr Fleytas next outlined that GEOLab demonstrated how to use a survey and forum and the significance of engagement and awareness-raising to raise community participation significantly.

He described that in addition to the communities, the authorities collaborated with the community early on to improve the early warning system. GEOLab's interest was to engage the various stakeholders—firefighters, public forces, local authorities, municipality or governing authorities, civil society, the vulnerable population, schools, universities, and the local and national press—to communicate and disseminate information about the early warning system. GEOLab further wishes to integrate different platforms in real-time for the first time, using DVS. He next said that the NASA platform was another option and subsequently presented the prototypes from which, in conjunction with all survey data and additional variables, GEOLab generates a risk map based on the collected information and data set. In conclusion, he noted that it enables GEOLab to create a prototype for an early warning system.

## COUNTRY PERSPECTIVE ARGENTINA: MR DANTE GUGLIELMIN & MRS NATALIA ZARKO

The Ministry of Environment and Sustainable Development made the presentation on Argentina. Mr Dante A. Guglielmin, Head of Chair, Forest Protection and Mrs Natalia Zarko conducted joint presentations. Mr Guglielmin began his speech by discussing the historical context of early warning systems in Argentina. He noted the assessment carried out on fire hazards in 2000, and after gathering global data, the unit employed the Canadian method to arrive at its status. He explained that Argentina selected the Fire Weather Index because it better suited the requirements and the existing infrastructure. In 2012, the Ministry implemented the index nationwide and built the capacity of more than one hundred technical experts and one thousand individuals under the FWI framework. He said the organisation had to modify the Canadian system because the country has streamlined vegetation. In the present context, he mentioned that fourteen national parks employ this method and that some regions have used it for seven or eight years.

He then explained that in 2010, the Ministry initiated technical events and seminars and formulated standard criteria for implementing the index as significant milestones in the system's deployment. In 2016, it held the first course on a distinct subsystem, the FBP system, which produces fire behaviour. Currently, Argentina is utilising the sub-index that is most relevant depending on the region as it was preferable for pastures when bad actors are present. He then noted that the next step is to contemplate other fuels to be humanoid, which is more effective for the region in question.

Mr Guglielmin additionally clarified that a particular aspect of early warning comprises all the periodic products issued by the SNMF based on various categories of hazards defined based on specific FWI percentiles. He next discussed the sub-prevention system up to 24-48 hours, based on information provided by the National Meteorological Service. According to the presenter, the information is public knowledge, and all citizens have access to the FWI's updated data and reports. The Ministry further generates draught codes depicting the fire season's evolution and completed for Argentina's 92 meteorological stations, and the values are colour coded. He further noted that Argentina's fire registry database relies on what each jurisdiction reports. In contrast, some jurisdictions report one hundred per cent of fire events, while others do not disclose them. Therefore, national statistics are limited.

According to the presenter, the Ministry creates unique mapping and reports for the most significant and severe disasters. Next, it divides the country into six regions and produces a weather forecast for each. Additionally, the system enables meteorological information during the season and is updated every Tuesday and Friday. Another product forecasts forest fires and prescribed identities in collaboration with the National Weather Service as required by law. It was next clarified that meteorologists forecast six times a day due to the Ministry hiring meteorologists for the national parks. As a result, they found that 81 per cent of planned or unplanned fires occurred in areas with warnings, alerts, or messages. In addition, the Ministry's monthly and quarterly evaluations include all expected weather variables.

Next, the presenter explained that Ministry had 30–40-meter towers with multispectral cameras that detected and reported heat around the clock and transmitted data to two monitoring centres. Another important factor was that the Ministry of Environment purchased seventeen drones for national parks, improving fire detection, suppression, and conservation as deterred poachers, helped find lost people, and deters; hence, the interest was to expand.

Further, the presenter explained that despite being expensive, it effectively spotted temperature anomalies. Finally, hotspots identified by alert or warning thunder monitoring activate preventive flights in various locations, and the Ministry works with the armed forces using similar aircraft for detection. The presenter further noted that human activity caused 95 per cent of wildfires. Still, some natural causes, like lightning, are typically difficult to access. Therefore, the Ministry collaborates with the Ministry of Defence and the meteorological service to improve detection.

## COUNTRY PERSPECTIVE BOLIVIA: MR ELIOT CASTRO MENAN

Mr Castro commenced his presentation by clarifying that he had simplified the previous day's presentation on the strategies for integrated fire management in Bolivia. He thus explained that the 'Aura's information monitoring system' was explicitly connected to monitoring and had no early warning system like other countries. The Ministry has based the System on national policies and fair laws. He clarified by and large that it was almost the only nationwide data system with three modules and the data system provides an average forest monitor that oversees forest risk monitoring and forest forestry project management. Mr Castro next outlined that Bolivia has followed up on hotspots for the past few years and the recurring events have demonstrated that they help determine whether there is a fire risk. It has therefore helped the Ministry determine that certain areas have a greater likelihood of experiencing a fire. Moreover, the Ministry sends daily newsletters about these locations as a monitoring method.

In Bolivia, forest fires and burnings are operational concepts. He explained that 'Forest Fire' is when a forest is affected by a fire and utilised when fields are damaged. Mr Castro said that monthly and quarterly reports help the minister follow up on daily news, and the Ministry also connects with the field staff, locals, or community agents. He noted that they use WhatsApp groups so people can directly reach the administration and every unit for quick responses. After determining the probability that a hotspot will start a fire, the Ministry analyses earlier data, the distribution for these days, and how hotspots behaved during retirement and beta to identify a potential event and a warning.

Furthermore, he noted that the Ministry identified burnt forest areas as accurately and therefore, the Ministry knows fires are likely in hotspots and other sites. Another critical factor was that those hotspots caused 60 to 80 per cent of fires. Therefore, the Ministry utilises Sentinel images through Google and an algorithm that allows it to filter out some fires based on indices and algorithms. Next, Mr Castro presented the yearly occurrence where the Ministry collaborated with researchers to make the algorithm rapidly produce data, and the related work is under evaluation. In the future, the Ministry would have the option to have the algorithm to deliver monthly information more rapidly. He noted that information was crucial because a monitoring system is the backbone of the communication strategy pillar. To highlight the importance, he stressed that if, on a given day, the Ministry does not send out the reports, the entire communications strategy ceases to exist.

Mr Castro then explained that the Ministry had developed the System using open-source software, and users could access the platform to utilise the available services. It has several information systems, such as road and school information, telephone area data, etc. Respondents primarily used this to plan how they would access the land if there were direct soldiers. However, he noted that coverage is unavailable in specific locations in Bolivia. Therefore, the Ministry strived to provide them with all the information required to receive the service.

Next, clarifying how the Ministry managed hotspots to demonstrate fire movement, Mr Castro noted that Bolivia avoids the hotspot areas by temperature, and firefighters must be given accurate temperature information when they fight fires. The model used to manage hotspots is still used, but pixels are more accurate. Firefighters have died due to inaccurate data, so it is essential to treat them responsibly. Additionally, the Ministry is making a mobile application allowing locals to update the platform, and firefighters can send photos or observe. At the same time, field data support ongoing expertise. It concluded Mr Castro's presentation on Bolivia.

## COUNTRY PERSPECTIVE BRAZIL: MRS TALITA OLIVEIRA TARLEI DE FRIETAS AND MR LUIS PACHECO MOTTA

The presentation focused on the national system for fire information called SISFogo, and they carried out a joint declaration. Mrs Oliveira mentioned a draught bill with several instruments and policies, and the national fire information system is related. If the project is approved, she said this information would shed light on Brazil's proposed legislation regarding Prevfogo's data requirements in SISFogo. Mrs Oliveira also explained that SISFogo publishes prescribed and controlled burning and fire event warnings, reviews fire-related events legally, and clarified that Prevfogo requires fire warning system expertise.

The presenter emphasised that Prevfogo's alert-response capability must be genuinely feasible. SISFogo is a system currently being developed; therefore, Prevfogo intends to utilise data from various categories that emphasise images and other data types to generate information. A straightforward and uncomplicated system for all users, authorities, fire departments, etc., with whom Prevfogo maintains institutional relationships.

The presenter further outlined that in Brazil, the internal environment was crucial for data, information, and elections, and thus there is cooperation with the Amazon Protection System (SIPAM). They placed information and a fire report at the SIPAM centre that manages Amazon's operations.

She next noted that Prevfogo had hosted the SISFogo development meeting in Rio de Janeiro. Thus, the organisation had various stakeholders as the National Foundation, the agricultural reform institution, the National Preservation Institute, IMPI, and SIPAM. Further, it was noted that there is already a dashboard in place concurrently developed while creating SISFogo where one records fire occurrences and the other is for hotspots.

The presenter next described that Prevfogo has filters for specific operations and a viewer map and presented a visual image of the map used to execute integrated fire management initiatives. As the system incorporates vast data, Prevfogo is considering micro information that requires collaboration with multiple people in a specific location to simplify things.

Next, Mr Luis Pacheco gave examples of two satellite image processing samples. He noted that cloud data incorporates programmes such as Google Earth. He further described using Microsoft's planetary computer and confirmed that Prevfogo uses SENTINEL. The critical factor is ascertaining whether the information is shareable, processable, and deliverable. According to Mr Pacheco, it will enable him to advance and jointly build the programme and application. He further noted that Complex jobs are possible, including fuelling. In conclusion, Mrs Oliveira presented the new Prevfogo building opened a few days back by Marina Silva, the Minister of Environment, and it concluded the presentation done by Brazil.

## COUNTRY PERSPECTIVE COLOMBIA: MR JORGE ARIAS

Mr Jorge Arias introduced himself as a research engineer in the Amazonian Research Institute, representing Colombia. He presented Colombia's information infrastructure and outlined that the system architecture incorporates, among other systems, a national environmental system. He explained that the system allows for data collection from the on-screen structure. At a hierarchical level, Colombia's Environmental Information System is at the national level. This platform incorporates nationwide data and information, and the platform collects data from subsystems, which are territorial-based information systems. The territory-based system, in turn, is served by regional information systems at the local level.

He then described that the national, territory-based, regional, and local levels, unique to Colombia's Caribbean and Amazon regions, are the three levels where the research institute manages the areas and provides technical and scientific data for state decision-making. He clarified that the Institute backs the Ministry of the Environment, where territorially based systems are applied locally in municipalities and smaller areas.

Given the situation, the territorial-based information system is one of the Institute's strengths. Furthermore, as per Mr Arias, the Colombian system decides aspects such as how to put out fires and whether or not something has happened. During the dry season, the Institute turns on the hotspot monitoring roundtable every third day from January to April and at this juncture, the information systems come into play. Mr Arias further noted that the Department of National Disaster Risk, among others, works with the relevant stakeholder group. Thereafter, operational units receive notifications to ascertain if the event is happening and after detecting an event, the ministry triggers the country's protocols.

Next, regarding reporting, he noted that weather and location updates are crucial as they provide insight into temperatures or low precipitation and how they impact upcoming events. The Institute also has tools to zone fire-prone areas and foresee fires. Further, the federal government provides wildfire-prone maps along with monthly temperature and precipitation forecasts, daily and monthly. In 2023 the country experienced approximately 40,000 fires; he noted that this knowledge is vital for early fire prevention and control. In 2022 the record was 106,621. To highlight this aspect, Mr Arias provided visuals of Colombia's Amazon information system SeaTac which depicted hotspot density by category and location for 2023 with 23,249 numbers.

In describing the warnings, he outlined that every user receives an e-mail alert, including the environmental officials, as they control fires and wildfires. An essential factor is that the information is vital for Colombia's preventative efforts as it helps identify the hotspots with the largest concentration, leading to preparing the communities for the end of the dry season in April and December to March. Mr Arias additionally noted that deforestation, forest fires, and grazing use in the Colombian Amazon would increase in the current year, and the ministry found three main concentrations. Next, in presenting one example of the best park in Colombia, he explained how the Institute creates Colombian scenarios using the hotspots and related knowledge. He noted that specific communities lack emergency reaction teams, risk management units, and other authorities on alert to handle these issues in the territory. The Institute, therefore, generates Amazon-specific info, and registration is open to all within the alert system. He further noted that in 2022, 70 per cent of the Colombian Amazon was affected by fires burning 158,000 hectares of pasture and grasslands. A small portion affected the forests impacting 2 per cent of secondary flora.

Mr Arias next pointed out the boundaries of national natural areas which separate agriculture and livestock and explained that the region's burn scars come from monitoring the repercussions. Additionally, the poorest growth areas have increased transformation due to the widening of the agricultural border, which affects the forest. The forest development hubs work with local communities to preserve forests at various levels nationwide. He noted that one helpful tool was the local agreement monitoring module which uses 15 signs and 110 x 1,000 images to assess the producer's forest preservation efforts. Finally, he said that Colombia works with communities in addition to warnings and information systems to prevent agricultural border expansion.

## COUNTRY PERSPECTIVE ECUADOR: MR GUILLERMO FLORES

Mr Flores introduced himself as the forecasting expert representing Ecuador's Meteorological investigations Institute (INAHMI) and clarified that his presentation focused on forest fire monitoring and prevention. Therefore, the presentation was from the perspective of meteorological science and outlined the atmospheric systems of Ecuador as well as the variables that caused wildfires. Thus, he presented the intertropical convergence area, its influence on the equatorial region, and the northern and southern effects.

He outlined that Ecuador had many coastal areas and experienced rainy seasons. Further, Ecuador's coastal region experienced many storms during the rainy season, with heavy electrical disruptions. He then said that on the alternate side of the country, the dry season starts, wildfires increase, and eastern Amazonian disturbances reach the Ecuadorian mountain range. As the continent's south region experiences migration, it indicates high levels of humidity and high levels of precipitation. Additionally, the positive anomalies from a linear pattern enhance the intertropical convergence area, causing Ecuadorian rain.

He next noted that negative anomalies occur when La Niña occurs along the Ecuadorian coasts, atmospheric circulation is very arid, and the dry season is more challenging. In particular, he clarified that Ecuador has four regions: Island, shore, Amazon, and fourth and presented the varying climate categories for each area. He then clarified that the numerical model uses the realistic valuation system and enables the institute to monitor relative humidity across the country using their high-resolution relative humidity variable. According to Mr Flores, it forecasts the minimum temperature, country-wide surface circulation, and highness index. Further other monitored conditions include wind speed and highness index decide hotspots for flame detection.

He further noted that the institute employed the Fire Weather Index (FWI) to help analyse events and clarified that the institute derives information from the German ICA model, which utilises the same outcomes as in fire-prone areas, German methods are more detailed and accurate. The institute also uses shortwave radiation, which affects the country and identifies vulnerable Ecuadorian regions that may have more sunlight, especially as Ecuador is on the equator. Moreover, he explained that the institute shared anomalous information with a seven-day outlook for Ecuador's rain deficits and excesses, and extreme temperature indexes, which also matches the European model. The institute can predict which areas will have milder, drier weather. The system further provides for anomalous precipitation maps, incorporating the European model. Additionally, there are periodic information outputs, and the institute knows how decision-makers use negative or positive knowledge. He also presented the surface temperature, which is essential to the institute as it helps identify regions with rising temperatures and the previous day's sunlight, which may affect decision-making.

He next presented a colour-coded image depicting the region's daily sunlight. Once again, the institute bases the maps on the European model and has free chart transfer. He next noted that the Ministry of Environment conducts controlled burnings to assess fire behaviour. The prescribed burning experts use meteorological data and share meteorological reports and technical documents for specified burnings. Mr Flores then shared the format, which involved global collaboration. He noted the information would be beneficial if the entire region of South America or every country member of this group created a standard protocol for file-based warnings. After that, Mr Flores shared insight on the website, which locates the hotspot and displays the smoke trail. He noted that channel seven monitors areas near-real-time, and satellite images reveal fire intensity-related colour tones. Additionally, Companies share the high fire season fire count. Finally, he noted that Amazonian heatwaves are well documented, caused mainly by oil firms burning gas.

## COUNTRY PERSPECTIVE PERU: MRS ROMINA LIZA CONTRERAS AND MRS SHEILA GAMARRA

Mrs Contreras, Peru's first presenter, clarified that she oversaw the improved data monitoring unit of the early warning system and thus presented on the federal context of wildfire warning. She noted that SERFOR added wildfires to its early warning national network in 2018, and it follows existing National Network guidelines due to the pandemic and other hazards. A ministry resolution establishes procedures for a national early warning network; thus, it applies wildfire legal regulations law 2966.

She further explained that the national disaster risk management and reduction system, including wildfires, followed Climate Change Framework Act number 30754 and was a regulatory agency. The agency incorporates wildfire management as one of its primary responsibilities. She then explained that the National Early Warning System for managing wildfires consists of four steps: risk awareness, warning filing, communication and dissemination, and response capacity. According to Mrs Contreras, many organisations are involved, including overseeing tsunami surveillance during the fire season. Thus, there are weekly maps and study conditions addressing wildfires. As part of SERFOR services, monitoring efforts include the park ranger, and firefighting units prepared to respond to wildfires and producing a report on favourable conditions for fire events.

She explained that they verify the incidence of wildfires in protected areas considering the issued warnings. As a part of the monitoring and warning system that will generate daily hotspot reports, the institution has published geophysical insights that assist with vegetation index analysis and the frequency of Fridays. Furthermore, NASA provides three primary sources for the institution, and it has created an algorithm to utilise GOES 16 and 17 and a mask to eliminate potential erroneous positives. She additionally noted that they have persisted in their fire-related hotspots, whether wildfires or structures on fire. In such instances, they issue or identify all fire-related hotspots, distinguishing their various characteristics to issue fire alerts.

According to the presenter, in the past, SERFOR performed the system modules manually to identify warnings. However, now, SERFOR has access to a service to automate this examination of warning events, using Python and R to identify concentrations and convert them into wildfire warnings or alerts. Therefore, it uses hotspots to substantiate or confirm an active fire, but not necessarily its location due to the low resolution. This information is continuously monitored via satellites to ensure that there are active fires, and the system validates the fire it highlights.

Next, she noted that the agency sends surveillance reports to document the date a watercourses hotspot daily patient route or routes to reach a fire, as well as the type of vegetation surrounding the area. They provide a short-term weather forecast, relative humidity, and precipitation and use weather and Wi-Fi to supplement the surveillance reports. Once a fire weather index event has concluded, the reports are issued twice or three times, and the fire's origin is determined once extinguished. Therefore, Sentinel is used to assess the images of fires using planet images, which are more accurate than Sentinel. She thus clarified they have daily access to the information, as opposed to every five days.

The Ministry of the Environment provides information on the affected area's ecosystem. SERFOR does not conduct a short-term analysis of the affected area, as a percentage of the broadband document comprises protected areas, and the remaining regions are archaeologically covered. SERFOR must be cautious with its actions, as it receives between 1000 and 2000 hectares and cannot estimate the size of the territory. Therefore, one must wait for the image so it can have a more precise calculation to ensure that the communications don't backfire or cause alarm among the population.

In conclusion, she noted that SERFOR uses hotspots, afflicted regions, archaeological sites, and wildfires to identify the afflicted areas. She said that the algorithm could be more accurate, but it displays an index and shows the location of affected or affected areas each year. To identify the sites, they employ thresholds, which are infinite for categories of ecosystems within each department. The organisation has a lengthy and tedious post-editing procedure to identify afflicted areas. It has examined the information on naturally protected areas impacted the previous year for the past five years, and the report has been targeted for complement in approximately two weeks.

Mrs Gamarra's presentation focused on media communication. She noted that the national forest communication system is an informational network. Furthermore, the institution administers it through a technological platform that provides information about vegetation and nature to various communities, private institutions, public institutions, and civil society so that they can make better-informed decisions.

The platform contains six modules and four components, and the satellite monitoring allows for audio monitoring. As mentioned previously, the system has collected information and all information is accessible in digital and varying formats. Mrs Gamarra said that additional surveillance and impact reports are required to manage data more efficiently and make it available to public, private, and civil society institutions.

Finally, SERFOR's response capacity represents the fourth component, and it utilises a rating system for wildfires. The design incorporates various risk management institutions, and this rating system allows SERFOR to develop capacities. The procedure for certifying individuals responsible for battling fires in Brazil is quite agile across the organisation of specialised training initiatives. In conclusion, Mrs Gamarra clarified that they are standardising the implemented study schedule, which will be launched during the current year.

## COUNTRY PERSPECTIVE URUGUAY: MR MATIAS OCAMPOS AND MR GABRIEL CAVICCIOLI

The day's final presentation was by Uruguay and presented first by Mr Ocampos from the National Unit of the National Warning System, together with Mr Gabriel Caviccioli. He commenced his presentation by introducing systems currently in operation and those undergoing development, beginning with the National firefighting department. He noted that the department conducted daily aerial surveillance within the National Aviation Department and United States Air Force in the country's most dangerous regions. He next presented an Uruguayan national forest in which the forest Industry society has an early warning system that includes Area aerial surveillance. Therefore, the fire metrology Institute is responsible for publishing the daily forest fire risk index and the FWI, posted on the SINAE and the CNET websites. According to Mr Ocampos, SINAE has devised an internal system to report potential hotspots, which is then relayed to firefighters using the information provided by the GOES-16 satellite. Additionally, they use firefighter cameras and drones to survey each location to coordinate joint activities. He then passed it on to his colleague.

Mr Gabriel Caviccioli introduced himself as another member of the National Emergency office in the information unit where information processing occurs resulting from varying emergencies. Mr Cavicciolli is responsible for wildfires. He noted that they began by validating information regarding fire severity and afflicted areas, as well as the early warning based on hotspots. He noted that when identifying hotspots, the agency includes the coordinates and information for that hotspot, and they are known to be isolated hotspots. In addition to the alerts, the bulletin is developed using open-source software. SINAE validates these studies by comparing them to actual fires. He next explained that SINAE observes the hotspots, along with the presence of vegetation. Cases, the foliage was verdant and not parched. Therefore, the initial assumption relates to fires which are anthropogenic in nature and it has thus led to SINAE researching the population's behaviour. Consequently, it further complicates the current phase of information gathering and requires combining satellite data with an assessment of the condition of the vegetation.

Mr Ocampos presented the preliminary reports generated when they determined no fire event. He noted that the system does not provide precise locations and only a rough approximation. In addition, the team creates daily maps and landmarks, which leads to conducting more in-depth analysis with Sentinel and Landsat images.

Mr Caviccioli then presented a regional example. He noted that it now uses algorithms that perform tasks automatically but requires manual input of images to carry out the relevant operations. Once again, he noted that the environmental context was sensitive to aspects like clouds. Next, regarding the early warning systems, SINAE generates a time series using the vegetation coverage index from the VCI Index System and performs a 10-year time analysis. Thus, in comparing the last ten years to the average, one can see several drier regions than usual. Moreover, it has been established by SINAE that the region is drier than usual in the current year, but it is not dry vegetation; instead, the area is burnt by human activity. He explained that such sites would receive more attention than verdant ones.

The presenter next demonstrated how SINAE uses CNI, related to information registries, as a monitor to record flood and fire events. It includes a validation process and geographical information; however, geo-referencing is only sometimes precise and accurate. Thus, SINAE collects satellite information related to ground information. He further explained that SINAE has concurred with other institutions on the categories, such as interface interfaces, planted areas, and native areas and the information was available to the public as open data. For the moment, SINAE analyses the incidents using a comprehensive post-event analysis for the more significant hour. Mr CavicciolIi believes they can be utilised and incorporated into a single early warning system.

He noted that SINAEI compared two NASA services and presented SINAEI's Information Management workflow. After a fire, the unit will make the maps and update the system with vegetation anomalies. Next, he introduced the GP firefighting registry and media information follow, a firefighting registry system, and media-related information, resulting in report generation. In conclusion, he noted that SINAE must validate all data before publishing any aspects.

## CONCLUSIONS: CONCLUDING REMARKS AND DISCUSSION

Ms Simona Obreja, team leader of the EU-Latin America & the Caribbean Policy Dialogue, addressed the delegates briefly.

She expressed that during the COVID lockdown, Dr San Miguel said he would like to create a short video or brochure about the services the network of wildfire experts provided. Ms Obreja further confirmed that the annual report for all participants is complete and will soon be published. She explained that the project had held bilateral meetings with all countries during the past two and a half years, and some of these results would be disseminated and communicated to expand institutional knowledge, making it available to the public.

In conclusion, she noted that all information would be published on the project's website, the link to which has already been sent, and continue to add new presentations so forth to the website. Therefore, it will be a virtual environment for the group to interact.

This led to the final segment of the day, which was moderated by Dr San Miguel. Some of the key clarifications and discussion points are outlined below.

- The recommendation was to create a virtual library or drop shares with useful procedures and separate folders for each nation to contribute additional information. In addition, it is essential to share information useful to others from the various agencies on various topics, such as the procedures they have in place or regulatory information. Countries may include legal documents, protocols, etc., in a section or on separate tabs on the TV's page.
- A delegate queried if there was a consensus or action plan across the group to seek out unconventional fire management solutions. This was followed by examples and contexts of Brazil. Additionally, considering the firefighters' risks earlier, robotic firefighting would reduce injuries and deaths. Thus, the importance to consider alternates in wildfire strategies and analysis, which could lead to reduced firefighting and fire damage and, importantly, allow experts to suggest or propose new lines of action and new technologies.
- Another delegate concurred, stating that it was an important point, and clarified the availability of studies on the total value of money a country lost. The best argument is, therefore, to demonstrate the profitability of investing in firefighting and prevention by demonstrating a country's loss. Therefore, discussing biodiversity in an advanced manner is essential, tying its monetary value and associated costs to the global economy. Fire suppression and prevention must have a positive economic impact. If not, we will continue to face difficulties.
- The delegate from Colombia proposed a roundtable on integrated fire management for Colombia, mainly to assist the country advance, as it is drafting an integrated fire management bill. The next aspect was related to understanding the hotspot verification protocol. Therefore, an appeal was made to the other countries to share their related protocols.
- Another delegate said firefighters, local authorities, and citizens who may be directly affected by forest fires would be the primary users in the case of early warning systems. However, other sectors may become institutional users or fall outside the institutional group. Tourism education can impact many individuals. Regionally, it would be beneficial to systematise the users and identify the type of product that can be introduced at each phase of an emergency or forest fire. Therefore, the delegate proposed investigating all sectors that may utilise products or services related to or about forest fires.
- To exchange information, it was further proposed to develop a plan that includes each country's interests regarding other countries' initiatives. It was once again suggested to create videos and conduct other preventative measures.
- Another delegate suggested that the group discuss exchange and dissemination. Each nation should specify which areas they are interested in and how they would like to cooperate. It was therefore proposed to incorporate a map of common interests to organise the group's work.
- It was further noted by another delegate that cooperation was critical and stressed the importance of countries needing to be ready to work together. To collaborate and recognise that they had different ways of collaborating with others.
- A second delegate revealed that drones, observation, and conservation towers were discussed with Argentina. They stated that the performance of the drones was satisfactory and that they would solicit bids from vendors offering basic drones for $2 million as the nation may require larger aircraft. Therefore, it was proposed that countries with the same technology could help connect with an EU initiative or proposal to assist our capacity-deficient nations. The nation could invest more wisely or utilise more fuel- and line-hour-efficient technology. The delegate remarked that it might also be of interest to other nations.
- Another significant and relevant factor was training programmes and capacity building for fire crew to fight forest fires. Potentially with the involvement of IBAMA, as they already provide the services.
- It was therefore noted that the training options would be recorded. As mentioned, all 27 EU countries follow a unit and protocol to welcome pilots. The group may consider calling colleagues to present these protocols and additionally invite them to the portal meeting. Another mechanism is potential with the support of the European Union, bringing other potential collaborators into the proposed meetings.
- It was explained that the MOU might include training and exchange programmes to share experiences as it was easy to coordinate actions to identify training supply and demand to create a roadmap and action lines for

training in the Amazon and other countries like Uruguay. It was further proposed to share the country-specific demands and plans to fund these training initiatives. Therefore, the proposal is to map what resources countries contribute while also identifying resources that other countries need.