



VAAC Wellington - Research Updates

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Outline

Current System: VOLCAT & HYSPLIT

New products:

- Quantitative Ash

- Ensemble products:

 - Probabilities of exceedance

 - Risk Matrix

New architecture

Summary



VOLCAT - VOLcanic Cloud Analysis System

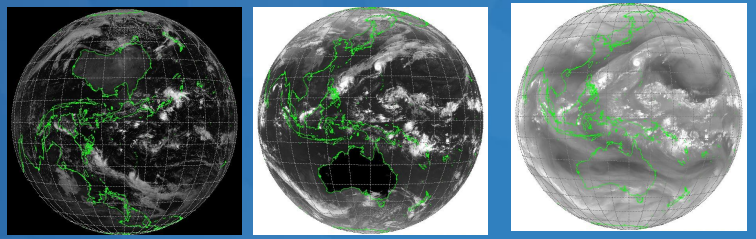
Detection of Ash Clouds



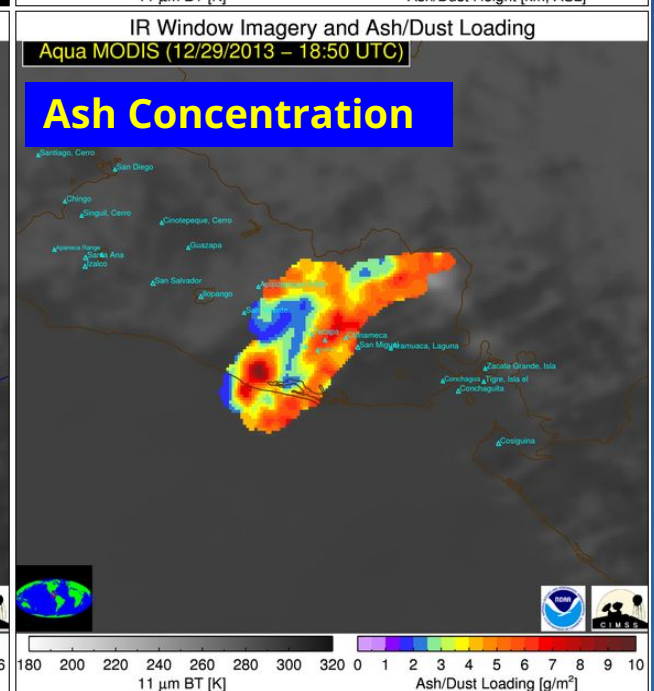
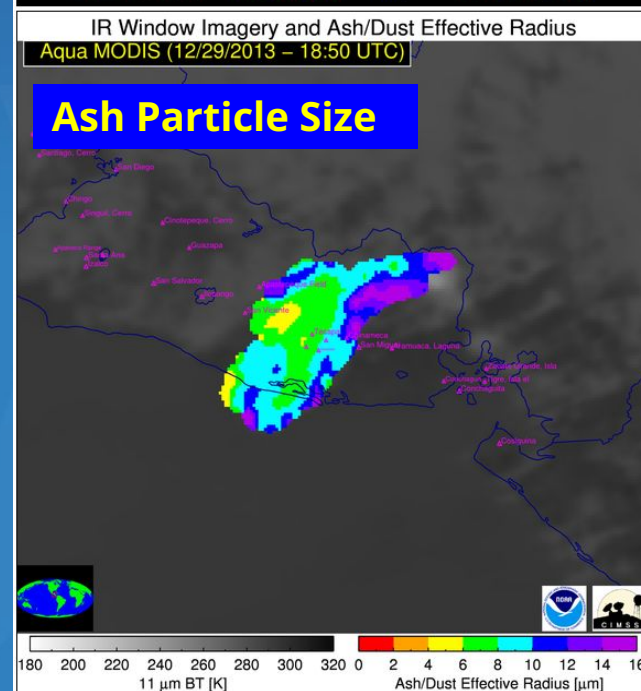
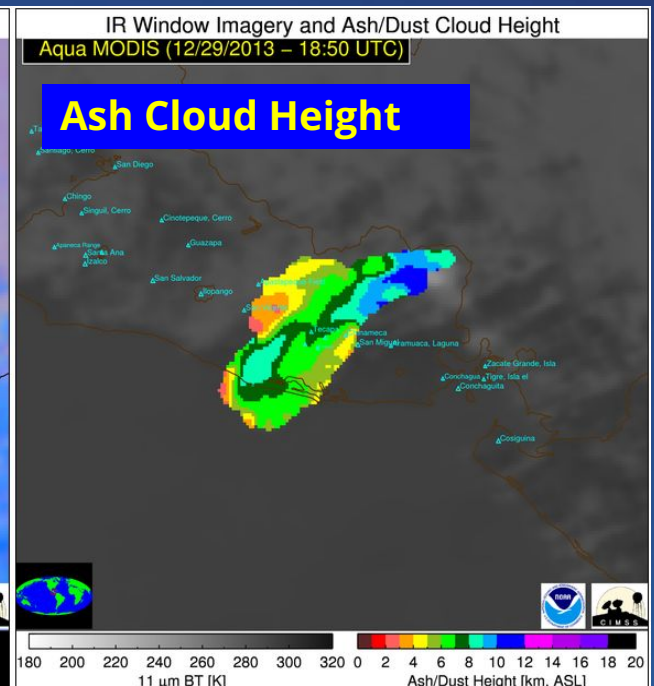
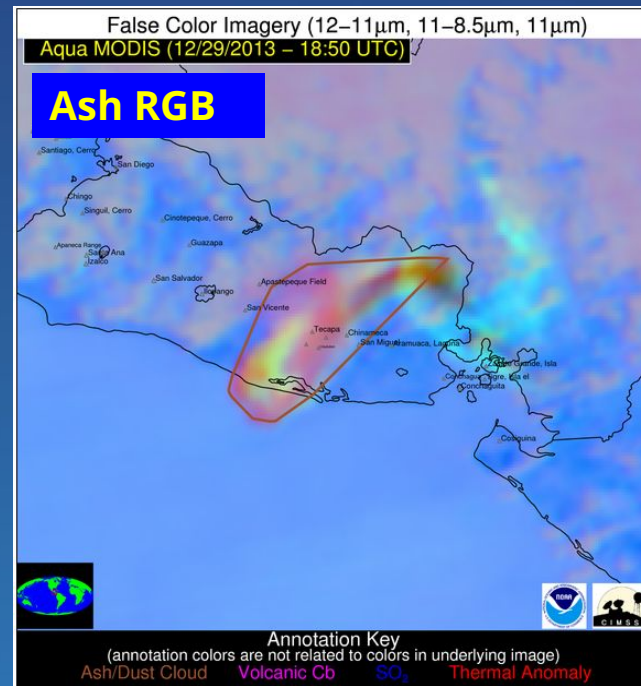
**Volcanic
Detections**

GEOCAT
Common framework

Ancillary
Data



Raw Imagery



Automatic Triggering of Dispersion Model

VOLCAT Alert

VOLCAT has detected volcanic ash at Yasur (Vanuatu, France). Please look at the standard volcat loop in Loopy and verify this event.

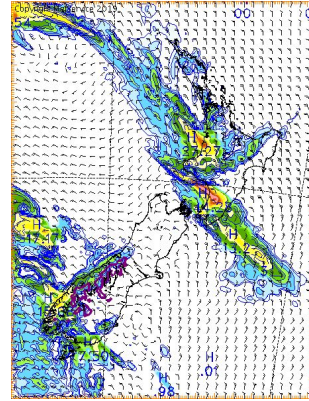
Details	
Image time	2021-10-17 15:40:00
Latitude of Radiative Centre	-19.53
Longitude of Radiative Centre	169.44
Maximum cloud height	8.3 km
90th percentile cloud height	8.2 km
Identification method	Plume/Puff Extraction (SECO+)

HYSPLIT has been triggered with the following set of parameters:

Defaults from Mastin et. al. for Yasur			
Label	Plume height (km AMSL)	Duration (h)	Mass eruption rate (kg/s)
small	2000	100	5000
moderate	7000	60	100000
large	10000	5	1000000

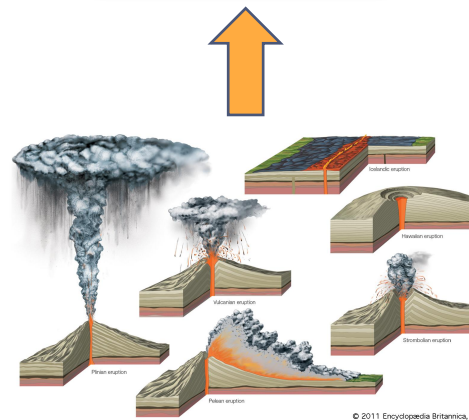
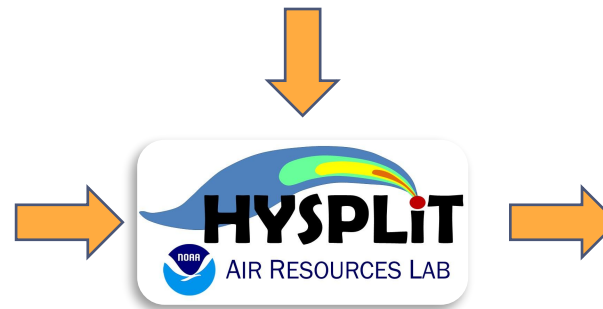
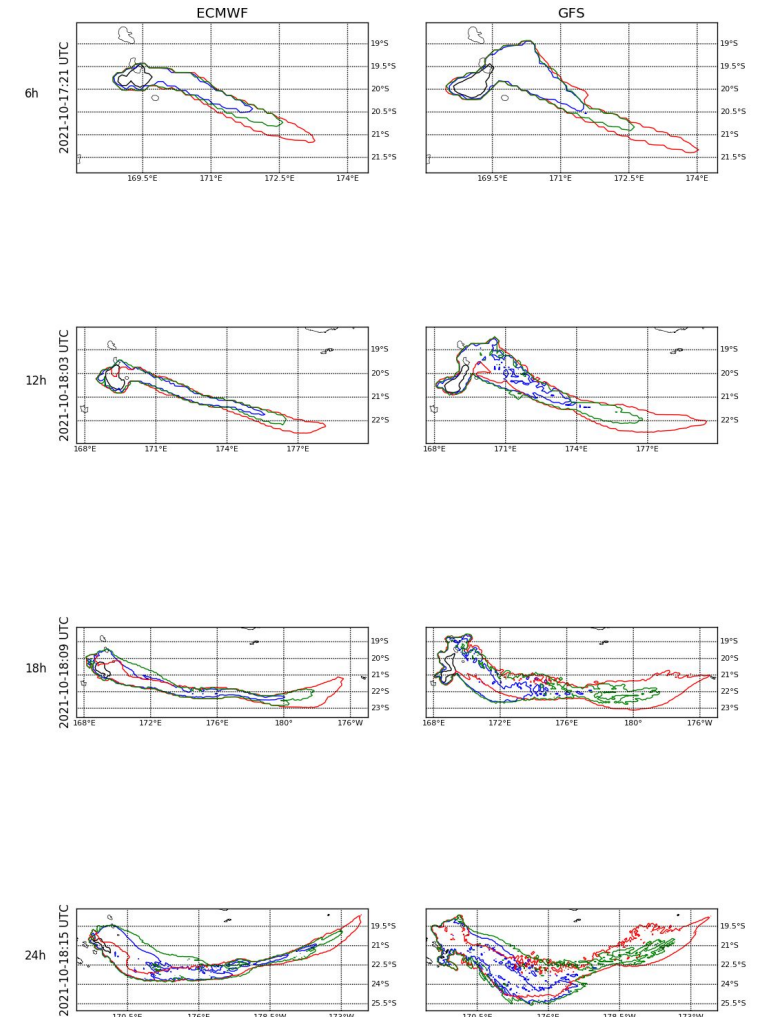
From VOLCAT retrieved cloud height			
Label	Plume height (km AMSL)	Duration (h)	Mass eruption rate (kg/s)
volcat	8200	60	665681

NWP



Forecast Dispersion Scenarios

— volcat — small — moderate — large

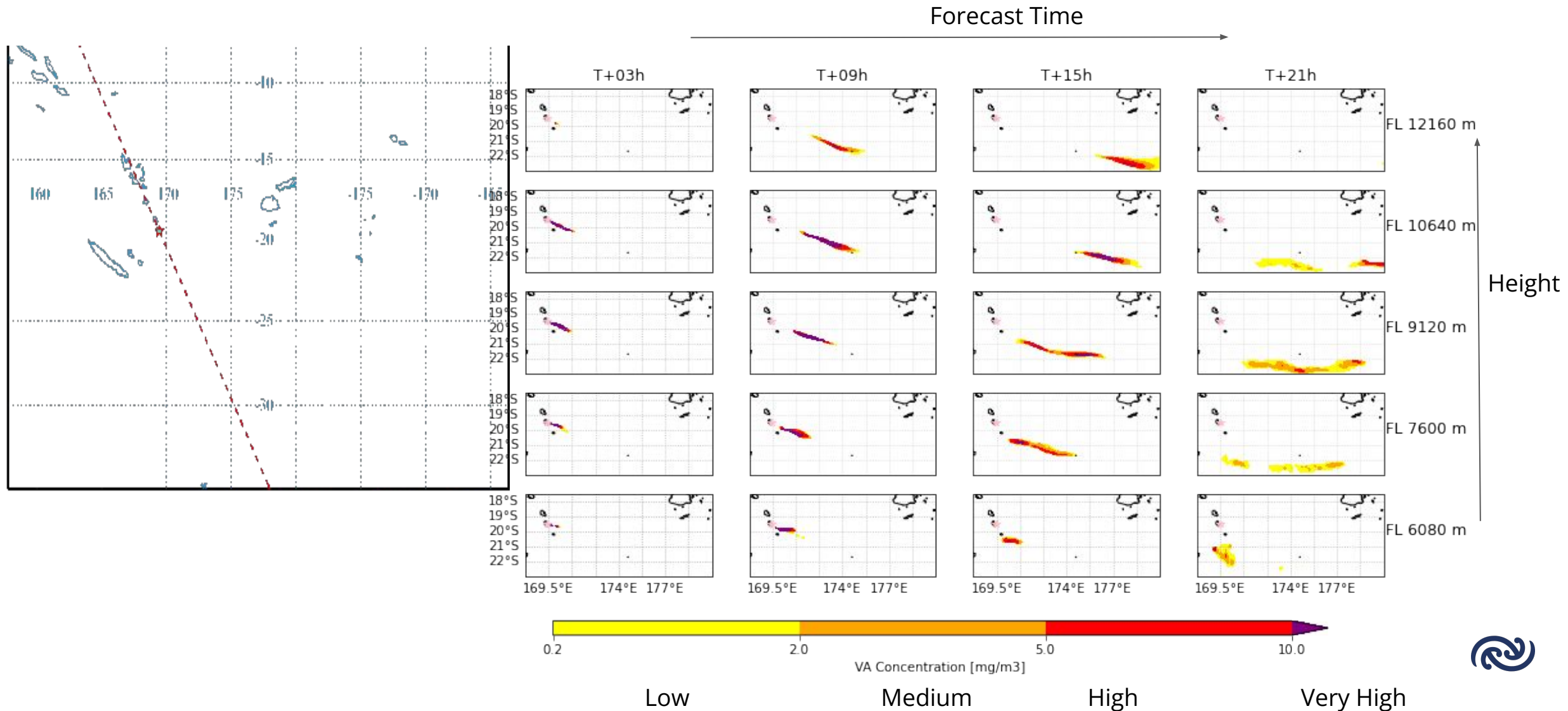


Eruption type DB

New products: Quantitative Volcanic Ash

Example: Yasur 2021-10-17 15:40:00Z

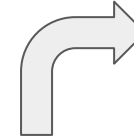
- In 0.1 deg resolution grid
- at every 500 ft
- Every 3h



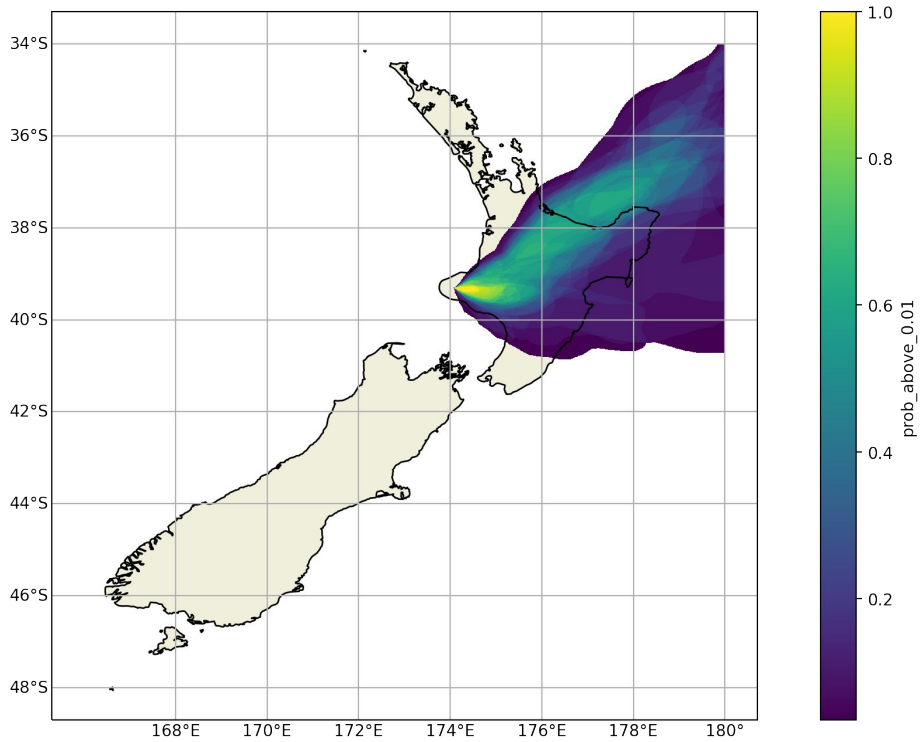
New products: Prob of Exceedance and Risk Matrix

Taranaki

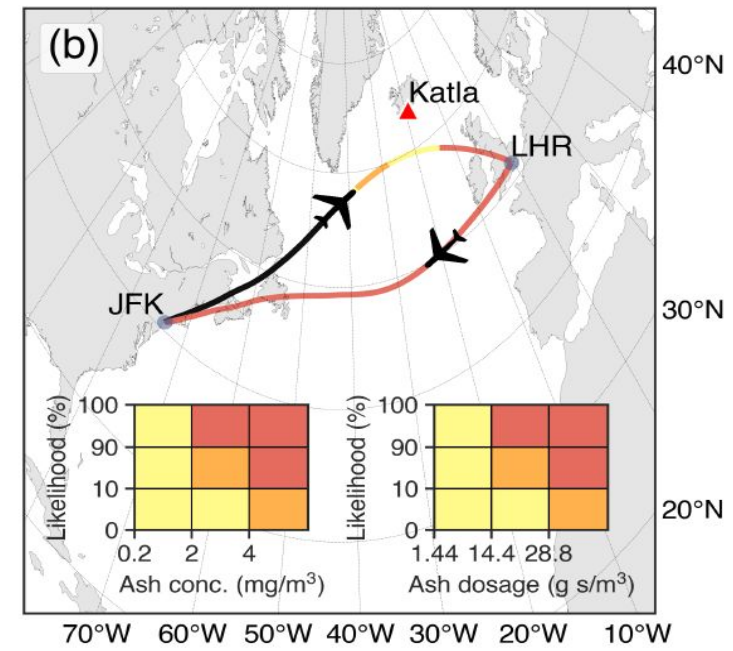
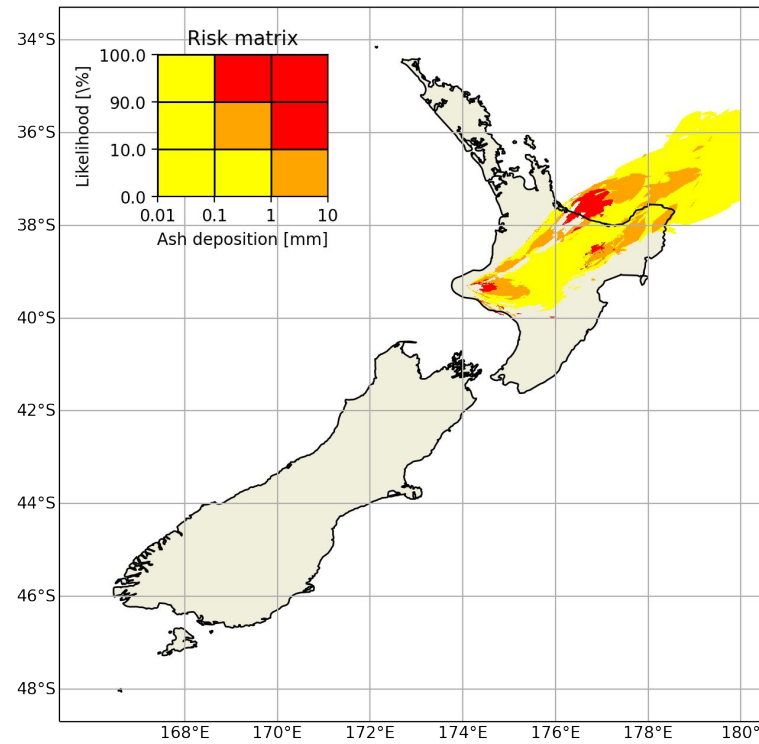
Ensemble of eruption parameters and GEFS



Probability of ashfall > 0.01 mm



Risk Matrix



Prata et al 2019



New AWS Workflow

Automation, Modularity, Timeliness & Reliability

- Containerized model (ECS **Fargate**)
- **Step** Functions orchestrate calling **Lambda** functions and ECS Fargate with appropriate arguments for pre/run/post processing
- AWS **CodePipeline** for versioning of code and automatic deploy of eruption configurations
- System to be triggered by **API** call from Forecasters Graphical **User Interface**

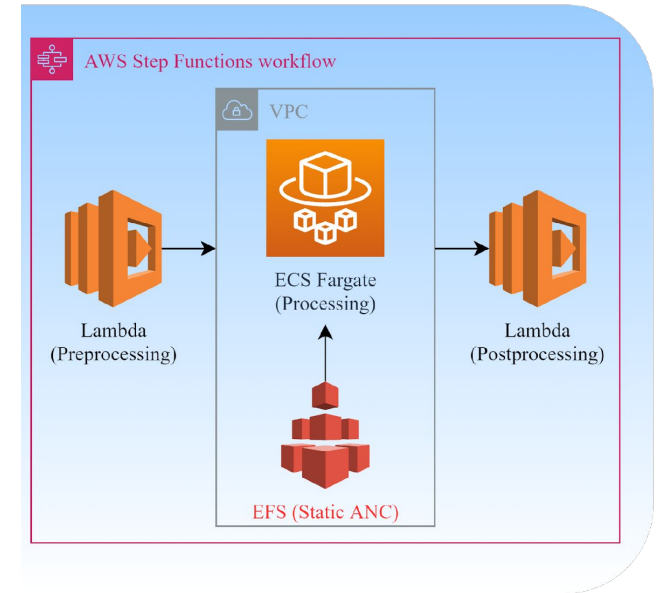
User Interface

The screenshot shows a web-based user interface for configuring an eruption simulation. It includes the following sections:

- Select Volcano:** A dropdown menu with 'Yasur' selected, and input fields for Latitude (-19.53), Longitude (169.442), and Elevation (361).
- Eruption Start Time (UTC):** A calendar view for October 2021, with the 26th selected. Below the calendar is a time selector set to 0:00.
- Eruption Parameters:** A table with columns for 'Known', 'Small', 'Moderate', and 'Large'. It includes input fields for Duration (hrs), Plume Height (m above vent), Eruption Rate (kg/s), and Calculated Eruption Rate (kg/s).
- Simulation Options:** Input fields for Simulation Length (hrs), Plot Area, and User Name, followed by a 'Run simulation' button.



API communicates eruption parameters and triggers Execution



Details	Execution input	Execution output	Definition
<pre>1 { 2 "unique_id": "4dee246c-2519-4f15-adc8-6578237be4fa", 3 "AWS_STEP_FUNCTIONS_STARTED_BY_EXECUTION_ID": "arn:aws:states:us d-861edc506a31", 4 "eruption_time": "202110260600", 5 "config_file": "ashfall-gns_nz4kmN-NCEP_WhiteIsland_low", 6 "max_wait_time": 20 7 }</pre>			



In Summary

Undergoing developments at MetService for Volcanic Ash Forecasts

Updated Hysplit model:

- Tuning code for **speed**

New and improved NWP forcing:

- **More levels and variables**
- Higher resolution ECMWF ANZ (0.1 deg)
- Latest MetService WRF NZ 4km
- **GFS ensembles**

Updated AWS Services

- **Automation, Timeliness & Reliability**

Modular system:

- Easier to run for different eruptions
- System triggered by **API call**
- Easier to add new products:
 - **Quantitative Ash**
 - **Ensemble statistics**
 - **Probabilities of Exceedance**
 - **Risk Matrix**

