Puyehue: Cloud evolution part one - into the Indian Ocean

Eyjafjallajökull, volcanic clouds, and aviation - one year on

Melbourne, 8 June 2011

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The example of Puyehue – C.Caulle

- Puyehue – Cordón Caulle volcanic complex (PCCVC) (40°35'25"S - 72°7'2"W)
  - A stratovolcano (Puyehue, 2236 m a.s.l.) of bimodal composition.
  - Fissure activity (17 km length) dacitic-to-rhyolitic in composition.

Strong impacts on local communities (fallout and remobilization)

PUYE – HUE
(puye) – (place)

Puye
(Galaxias maculatus)
Strong impacts on local communities (fallout and remobilization)

Bariloche, 04 Jun 2011

Villa Angostura, 05 Jun 2011

Ing. Jacobacci, 09 Jun 2011

Ing. Jacobacci, 14 Jun 2011
Strong impacts on local communities (fallout and remobilization)

Photos: Rodolfo Werner
Strong impacts on local communities (fallout and remobilization)

Photo: Rodolfo Werner, 27 June

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Photo: Rodolfo Werner, 27 June
### Modelling strategy

<table>
<thead>
<tr>
<th>Scale</th>
<th>NWPM (forecast)</th>
<th>Time</th>
<th>VATDM</th>
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</table>
| Meso-scale  | **WRF-ARW**  
24 km resolution (Lambert)  
38 vertical levels  
Top pressure: 50 hPa (20km) | 05-20 Jun   | Fall3d    |
| global      | **GEM**  
Global @ 33 km horizontal grid mesh | Hysplit (web-based version) |           |
| global      | **GFS**  
0.5° resolution                                                                   | 05-17 Jun   | Fall3d    |
| global      | **GEM**  
Global @ 33 km horizontal grid mesh                                               | 05-19 Jun   | MLDP0     |
Saturday 04 June 2011

- Well, eruptions always start on Saturday night. Preferably during holidays...
- SERNAGEOMIN reports an increase of seismic activity
- Column between 5 and 10 km (initial reports)
- First of all, have a look at the meteo forecast...GFS global model is 14 days ahead....

\[05\text{jun}2011 \text{ at } 01:00 \text{ Wind at } z=05000 \ (\text{m/s})\]

\[05\text{jun}2011 \text{ at } 00:00 \text{ Wind at } z=10000 \ (\text{m/s})\]
04 Jun 2011. The eruption starts.

07Jun2011 at 00:00 Wind at z=10000 (m/s)

09Jun2011 at 00:00 Wind at z=10000 (m/s)

10Jun2011 at 12:00 Wind at z=10000 (m/s)

12Jun2011 at 00:00 Wind at z=10000 (m/s)

Meteo forecast (available the 04 Jun)

05Jun2011 at 00:00 Wind at z=10000 (m/s)
04 Jun 2011. The eruption starts....

First, lets have a look at HYSPLIT results....
04 Jun 2011. The eruption starts....

WRF + FALL3D arrives later....

**METEO DATA TIME RANGE**
- Initial time: 05 JUN 2011 at 00 h 0000 s
- Final time: 08 JUN 2011 at 00 h 0000 s
- Meteo coverage: 72.0 h (259200 sec)
- Time lag: 0 days (0 sec)

**MESH**
- System of coord.: LON-LAT
- Bottom-left corner: (-75.0000, -50.0000)
- Top-right corner: (-45.0000, -20.0000)
- Number points x: 121
- Number points y: 121
- Grid incr. (deg): 0.25000
- Grid incr. (deg): 0.25000
- Min. topography: 0.0
- Max. topography: 4976.5
- Max. z domain: 19976.5
- Number z-levels: 16

**GRANULOMETRIC DISTRIBUTION**
- Number of particle classes: 7
- Diameter (mm): 16.0000, 4.0000, 1.0000, 0.2500, 0.0625, 0.0156, 0.0039
- Density (kg/m³): 1000.00, 1200.00, 1400.00, 1600.00, 1800.00, 2000.00, 2200.00
- Sphericity: 0.90, 0.90, 0.90, 0.90, 0.90, 0.90, 0.90
- Model factor: 0.90, 0.90, 0.90, 0.90, 0.90, 0.90, 0.90
- Percentage (in %): 0.0, 0.4, 8.7, 40.9, 40.9, 8.7, 0.4
- Sum (in %): 100.0
05-08 Jun 2011 forecast....
Today is 06 June and the eruption seems to be steady.
  • Is it going to last for a long period?

Develop a longer-term modelling strategy
  • Incorporate data as they emerge
    o Typically column height (hourly or daily averaged values depending on the case)
  • Use a restart mode for simulations with updated inputs
  • Data from satellites (can not be ignored!)
    o Are the simulations consistent with retrievals?
    o Redefine the a priori source term?

Message: models are the only way to forecast. However, it is essential to furnish model inputs based on observations
Longer term strategy

BSC-CNS, FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 FLFL100 (mg/m3)

BSC-CNS, FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 FLFL250 (mg/m3)
Fallout is also important....
Comparison with the satellite

Results
Forecast the impacts on a global scale....
Same strategy as before....
Same strategy as before…
Same strategy as before...

07 Jun 12h UTC
Same strategy as before ...

09 Jun 12h UTC
Same strategy as before...

13 Jun 12h UTC