



Puyehue: Cloud evolution part one - into the Indian Ocean

Eyjafjallajökull, volcanic clouds, and aviation - one year on

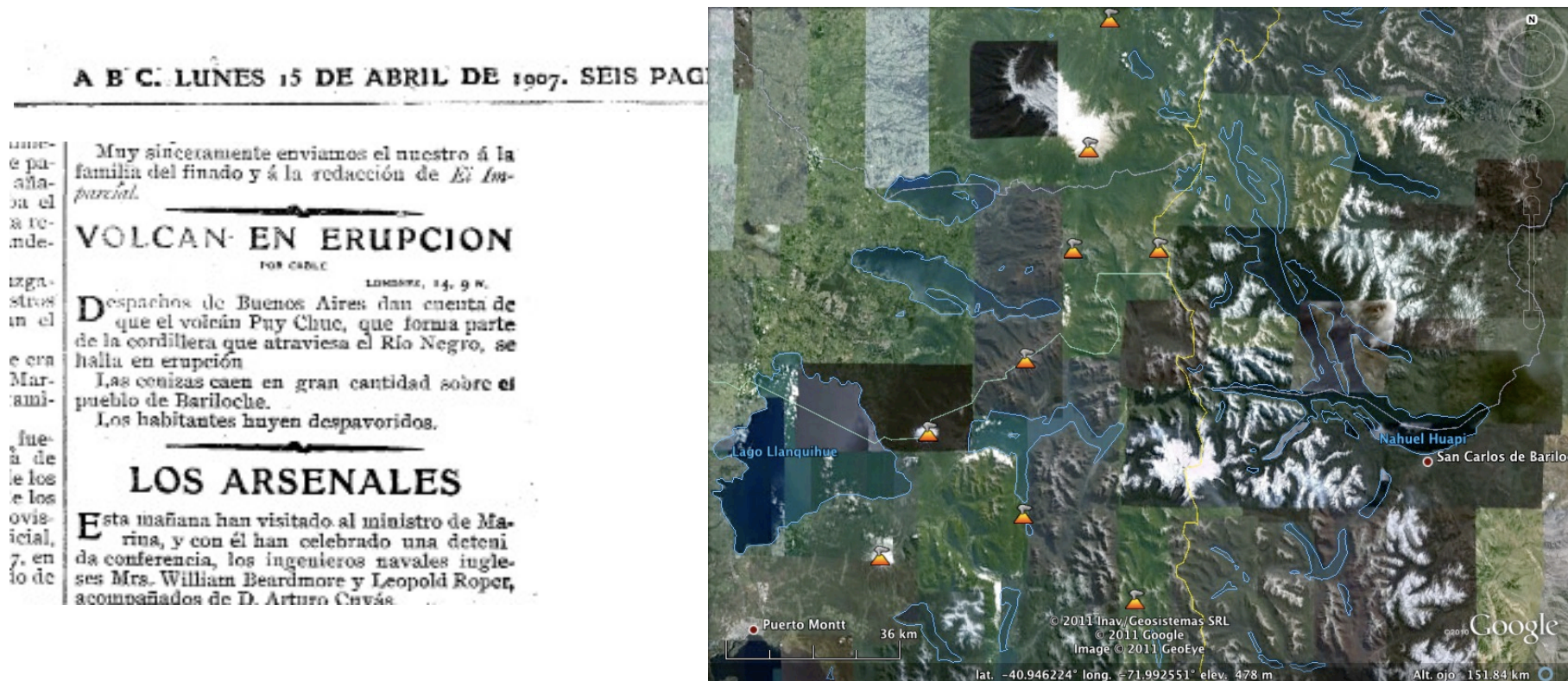
Melbourne, 8 June 2011

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Graciela Salmuni (CONAE) & José G. Viramonte (CONICET)

The example of Puyehue – C.Caulle

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

- PCCVC known eruptions 1905, 1914, 1921 – 22, 1934, 1960 y 1990.



Strong impacts on local communities (fallout and remobilization)

PUYE – HUE
(puye) – (place)

Puye
(*Galaxias maculatus*)



Strong impacts on local communities (fallout and remobilization)



Strong impacts on local communities (fallout and remobilization)



Photos: Rodolfo Werner

Strong impacts on local communities (fallout and remobilization)



Photo: Rodolfo Werner, 27 June

Photo: Rodolfo Werner, 27 June



Modelling strategy

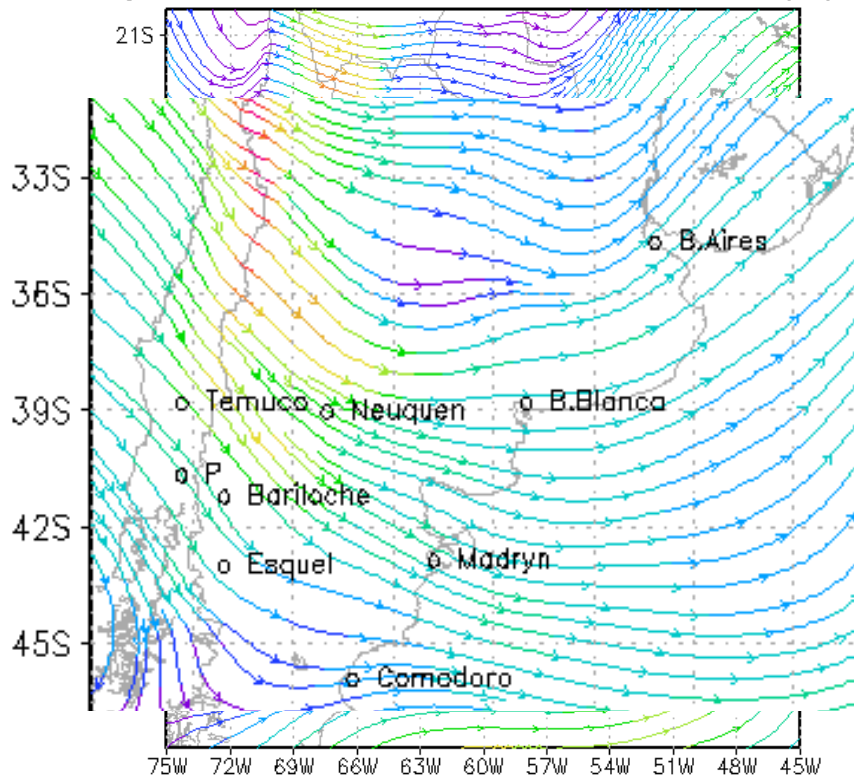
Scale	NWPM (forecast)	Time	VATDM
Meso-scale	WRF-ARW 24 km resolution (Lambert) 38 vertical levels Top pressure: 50 hPa (20km)	05-20 Jun	Fall3d
	GEM Global @ 33 km horizontal grid mesh		Hysplit (web-based version)
global	GFS 0.5° resolution	05-17 Jun	Fall3d
	GEM Global @ 33 km horizontal grid mesh	05-19 Jun	MLDPO

04 Jun 2011. The eruption starts....

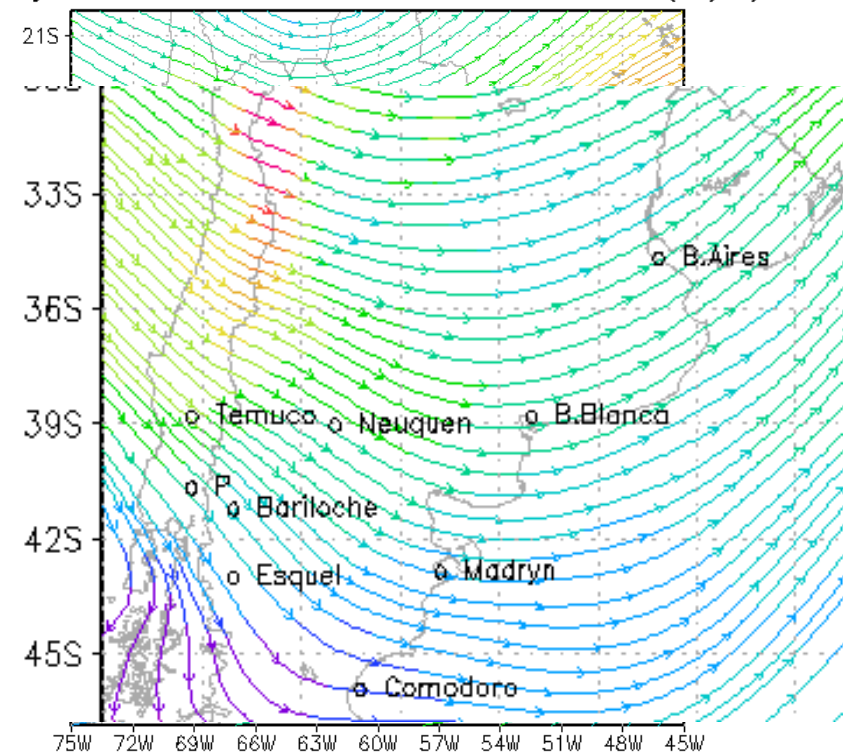
Saturday 04 June 2011

- 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...

05jun2011 at 01:00 Wind at z=05000 (m/s)

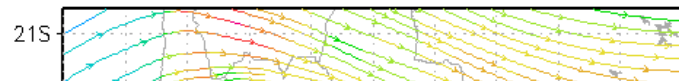


05jun2011 at 00:00 Wind at z=10000 (m/s)

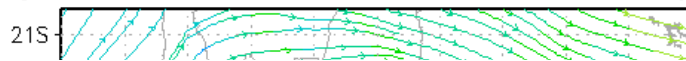


04 Jun 2011. The eruption starts....

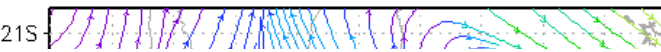
07jun2011 at 00:00 Wind at z=10000 (m/s)



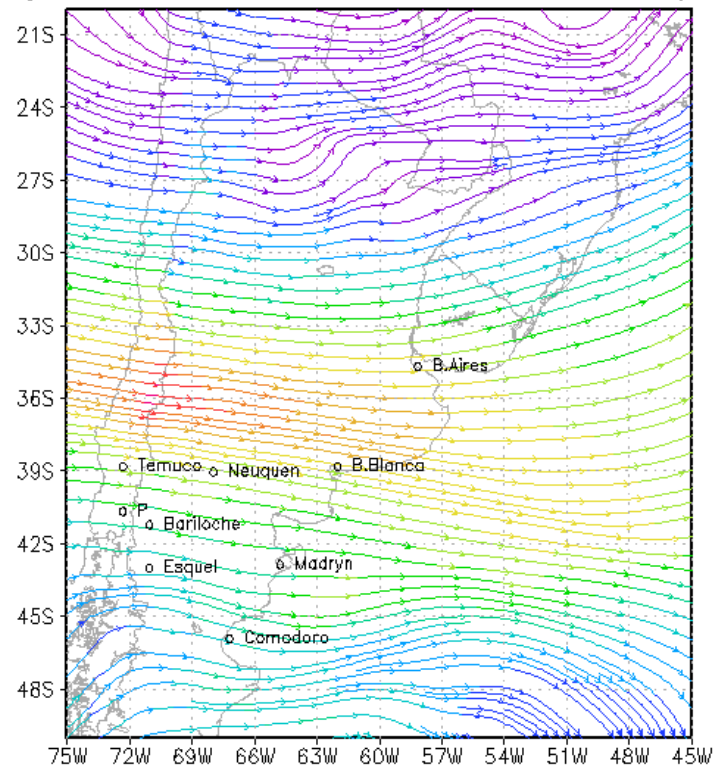
09jun2011 at 00:00 Wind at z=10000 (m/s)



10jun2011 at 12:00 Wind at z=10000 (m/s)

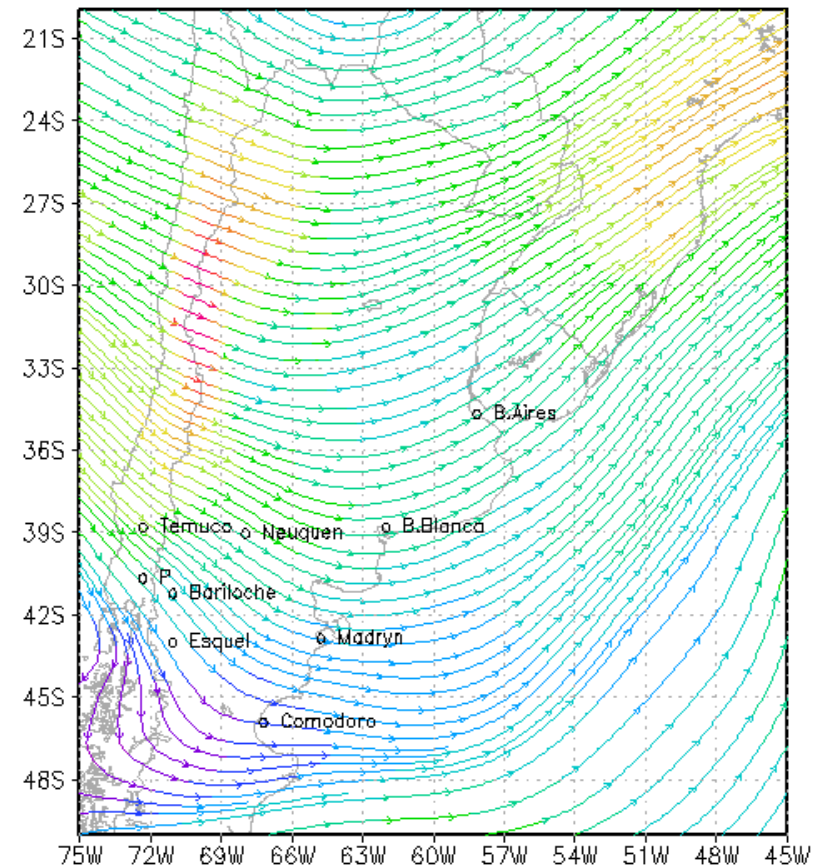


12jun2011 at 00:00 Wind at z=10000 (m/s)



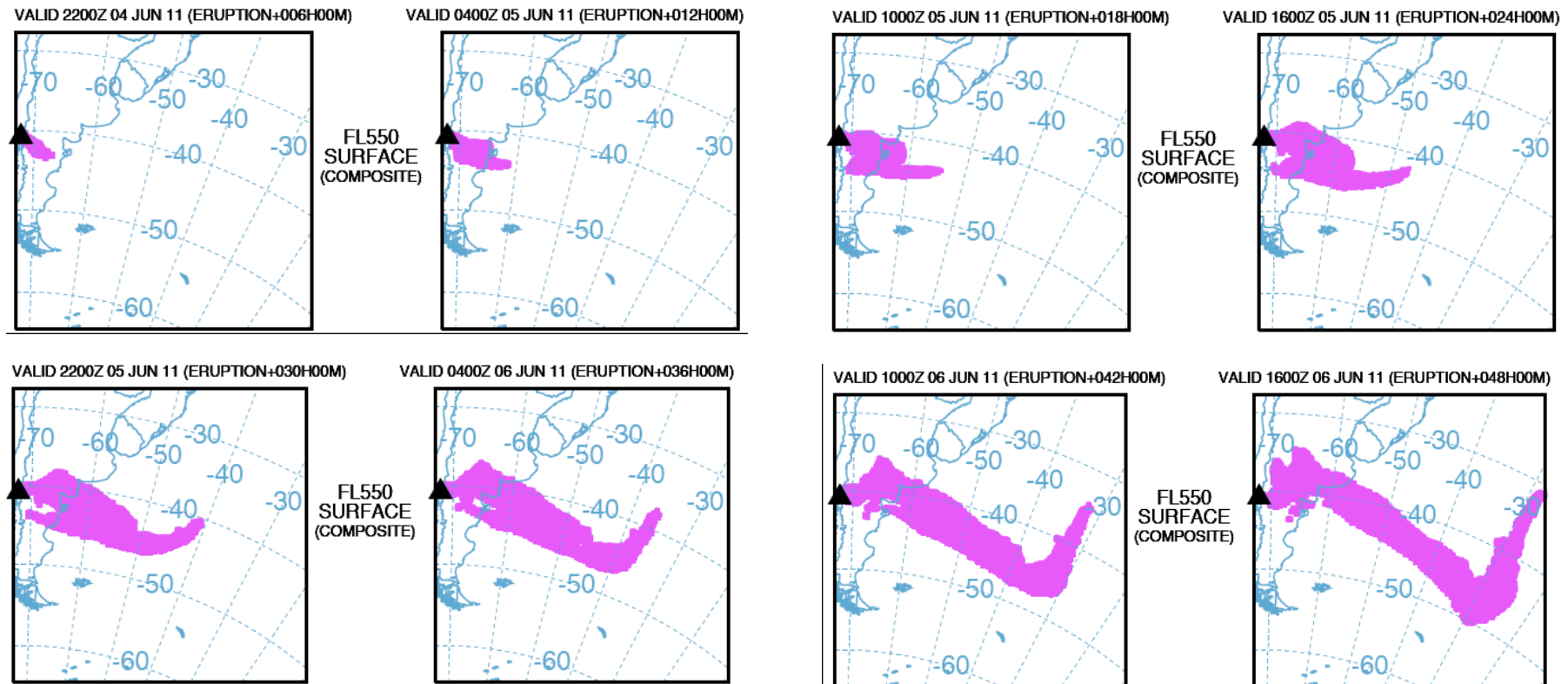
Meteo forecast (available the 04 Jun)

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

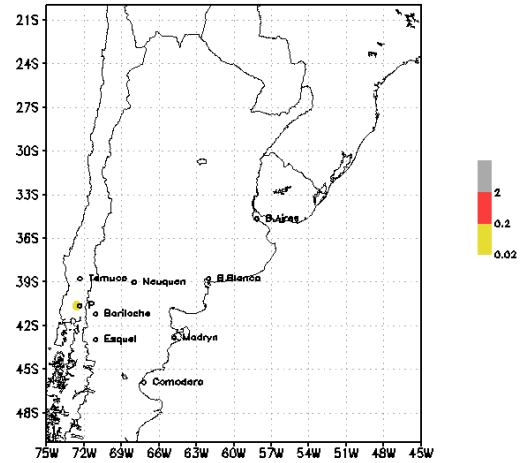
System of coord. : LON-LAT
Bottom-left corner : (-75.0000 -50.0000)
Top-right corner : (-45.0000 -20.0000)
Number points x : 121
Number points y : 121
Grid incr. (deg) : 0.25000
Grid incr. (deg) : 0.25000
Min. topography : 0.0
Max. topography : 4976.5
Max. z domain : 19976.5
Number z-levels : 16

GRANULOMETRIC DISTRIBUTION

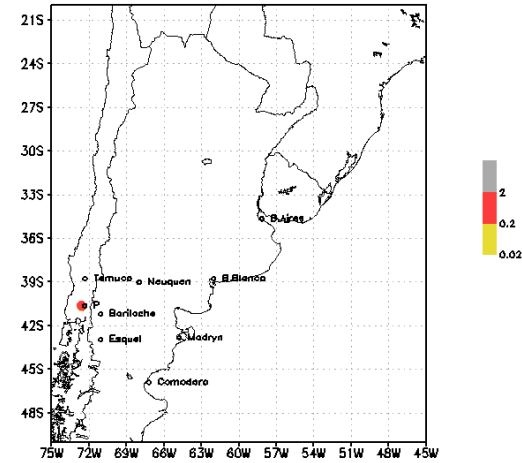
NUMBER OF PARTICLE CLASSES : 7
DIAMETER (mm) : 16.0000 4.0000 1.0000 0.2500 0.0625 0.0156 0.0039
PHI (-) : -4.00 -2.00 0.00 2.00 4.00 6.00 8.00
DENSITY (kg/m3) : 1000.00 1200.00 1400.00 1600.00 1800.00 2000.00 2200.00
SPHERICITY (-) : 0.90 0.90 0.90 0.90 0.90 0.90 0.90
MODEL FACTOR (-) : 0.90 0.90 0.90 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....

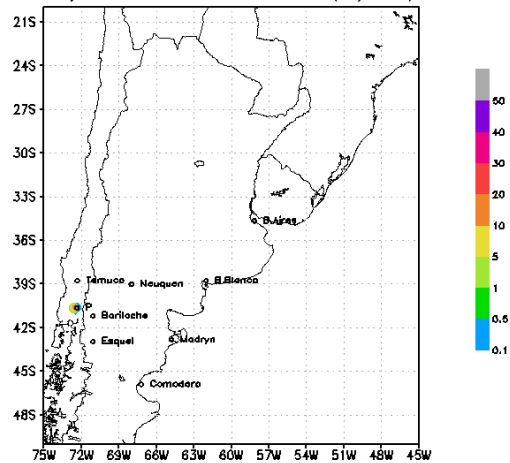
BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 FLFL100 (mg/m³)



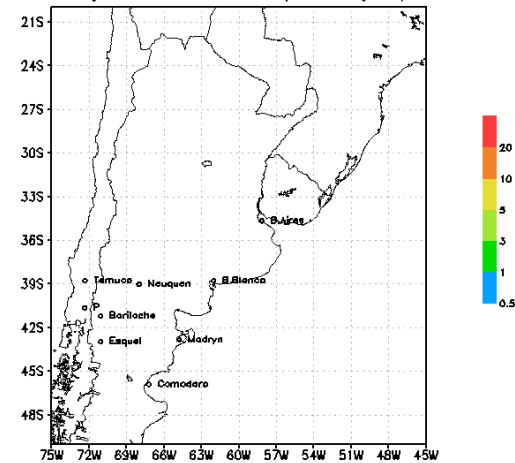
BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 FLFL250 (mg/m³)



BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 Col.mass (Tn/km²)



BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 Dep.thick. (mm)



Longer term strategy

Today is 06 June and the eruption seems to be steady.

- Is it going to last for a long period?

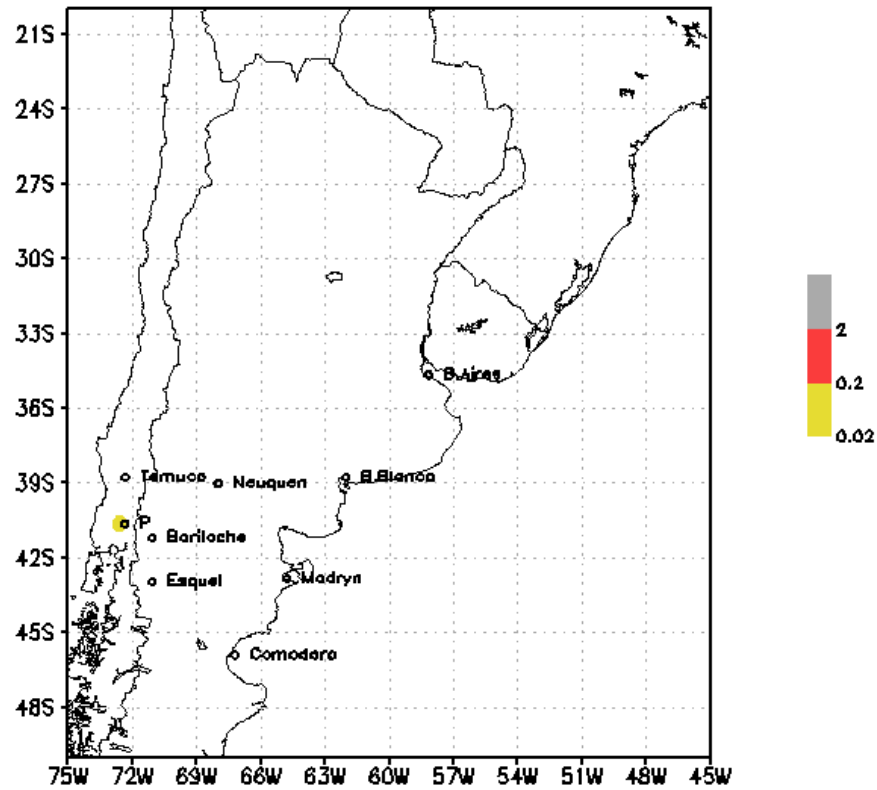
Develop a longer-term modelling strategy

- Incorporate data as they emerge
 - 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!)
 - Are the simulations consistent with retrievals?
 - Redefine the a priori source term?

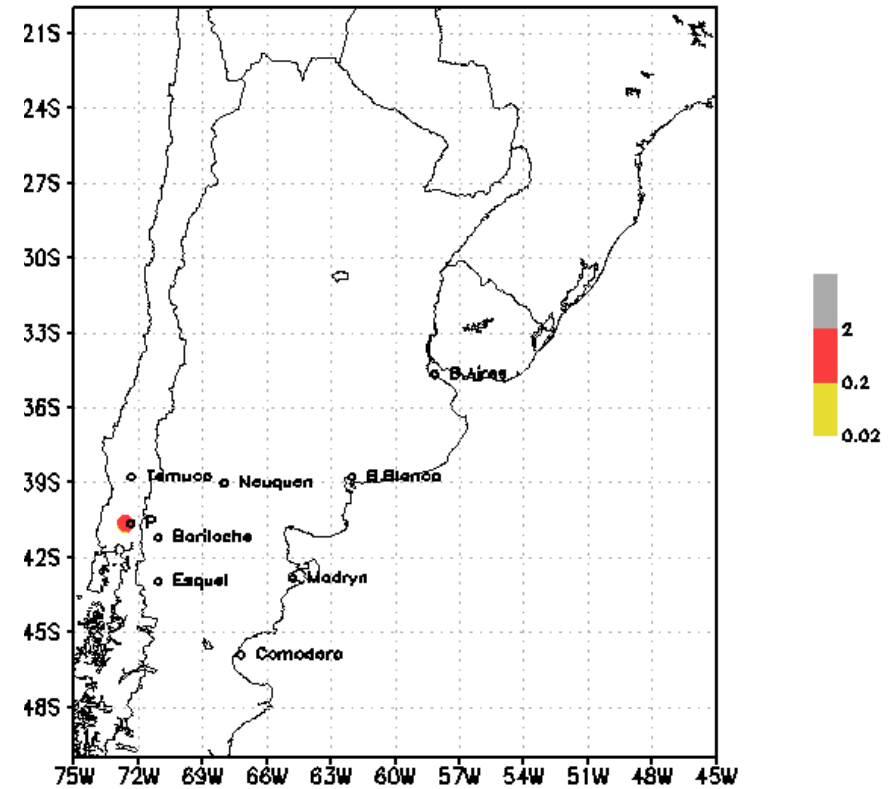
Message: models are the only way to forecast. However, it is essential to furnish model inputs based on observations

Longer term strategy

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



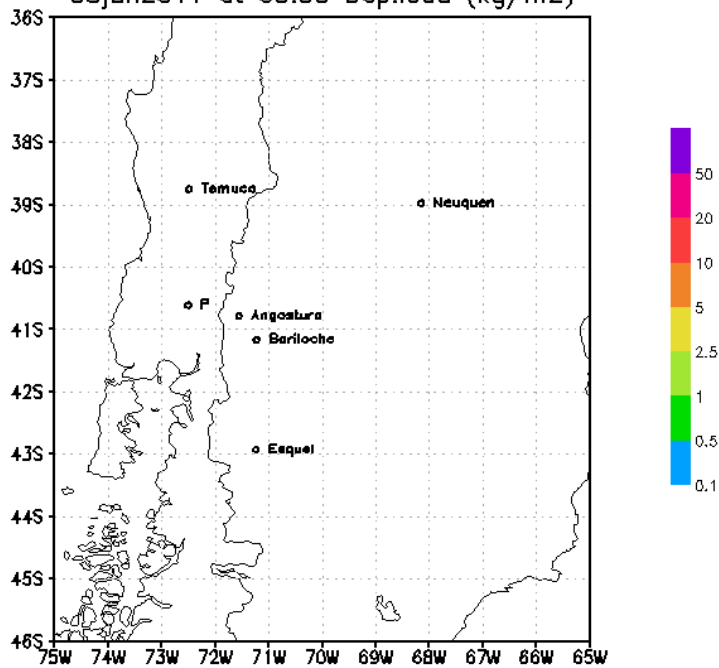
BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 FLFL250 (mg/m³)



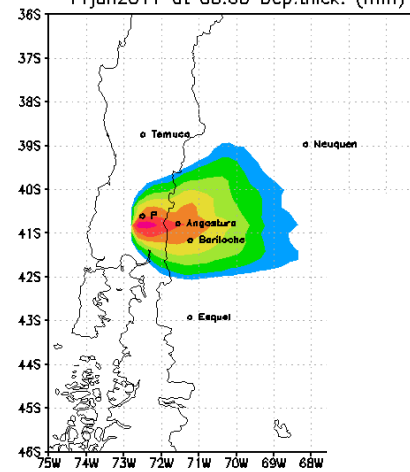
Fallout is also important...



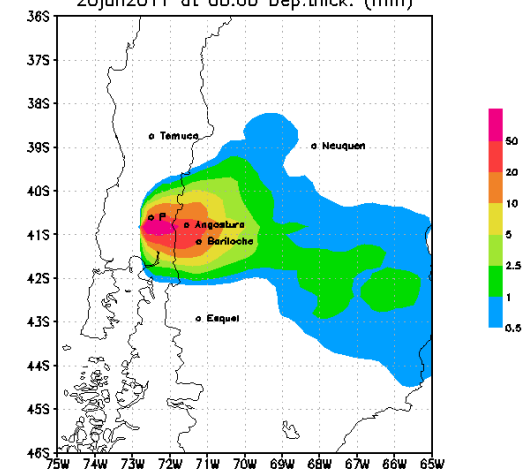
BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 00:00 Dep.load (kg/m²)



BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
11jun2011 at 00:00 Dep.thick. (mm)



BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
20jun2011 at 00:00 Dep.thick. (mm)



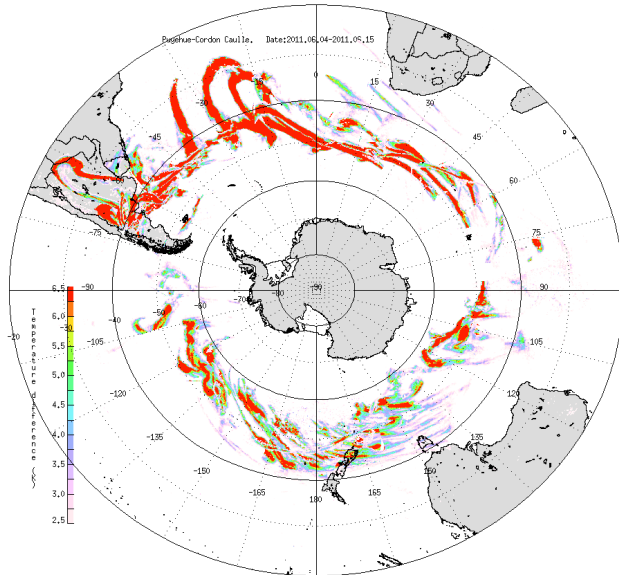
Comparison with the satellite

Results

Forecast the impacts on a global scale....

AIRIS 06-15 June 2011

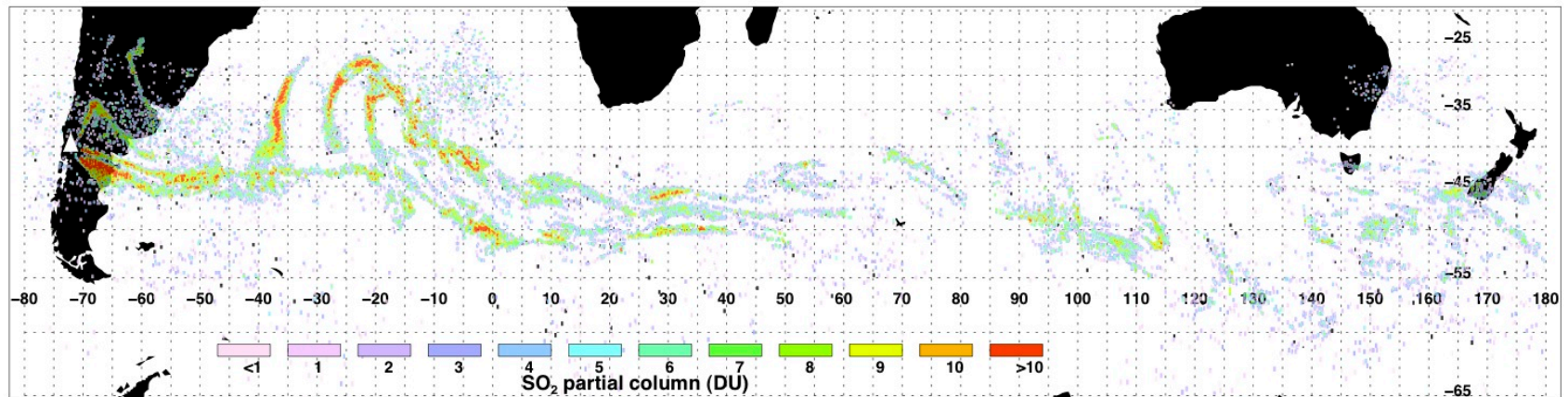
Image: F. Prata



AIRIS 04-12 June 2011

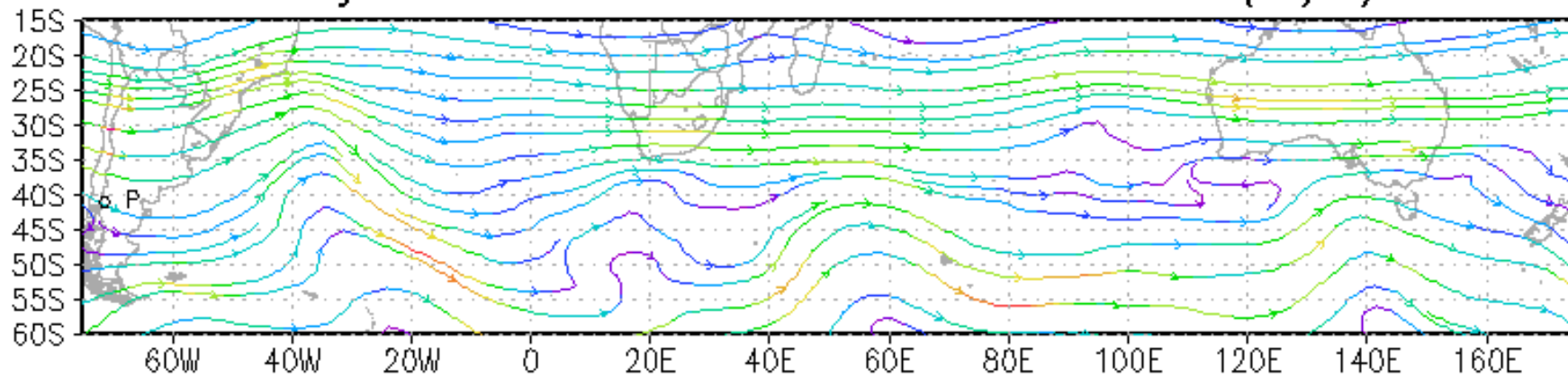
Image: F. Prata

AIRS SO₂ Partial Column Retrievals. ▲ Puyehue-Cordon Caulle Eruption. 4-12 June, 2011. Dr Fred Prata, NILU. Email: fred.prata@nilu.no



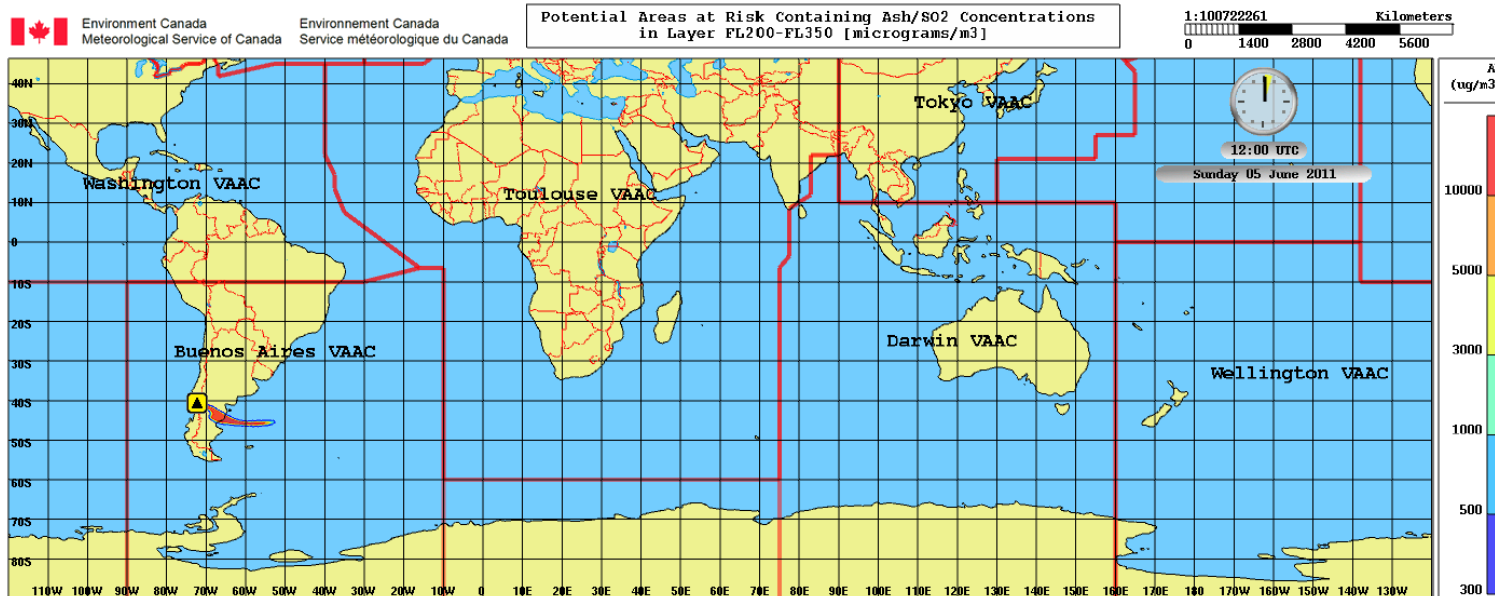
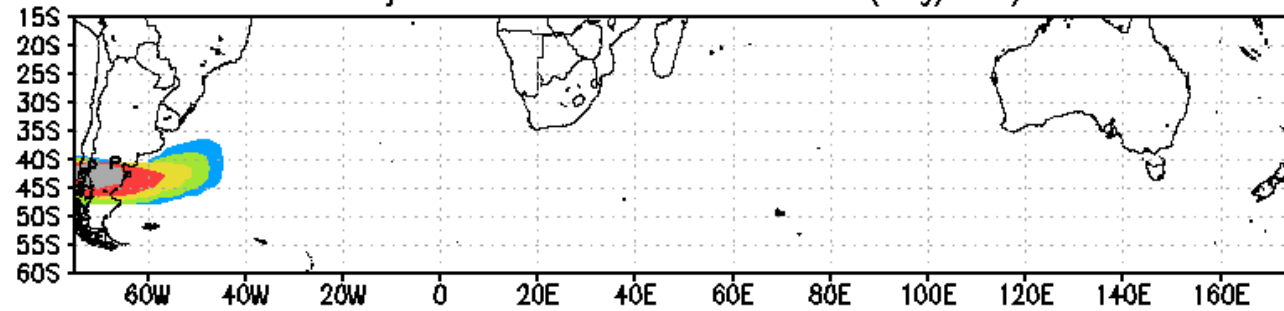
Same strategy as before....

05jun2011 at 00:00 Wind at z=10000 (m/s)



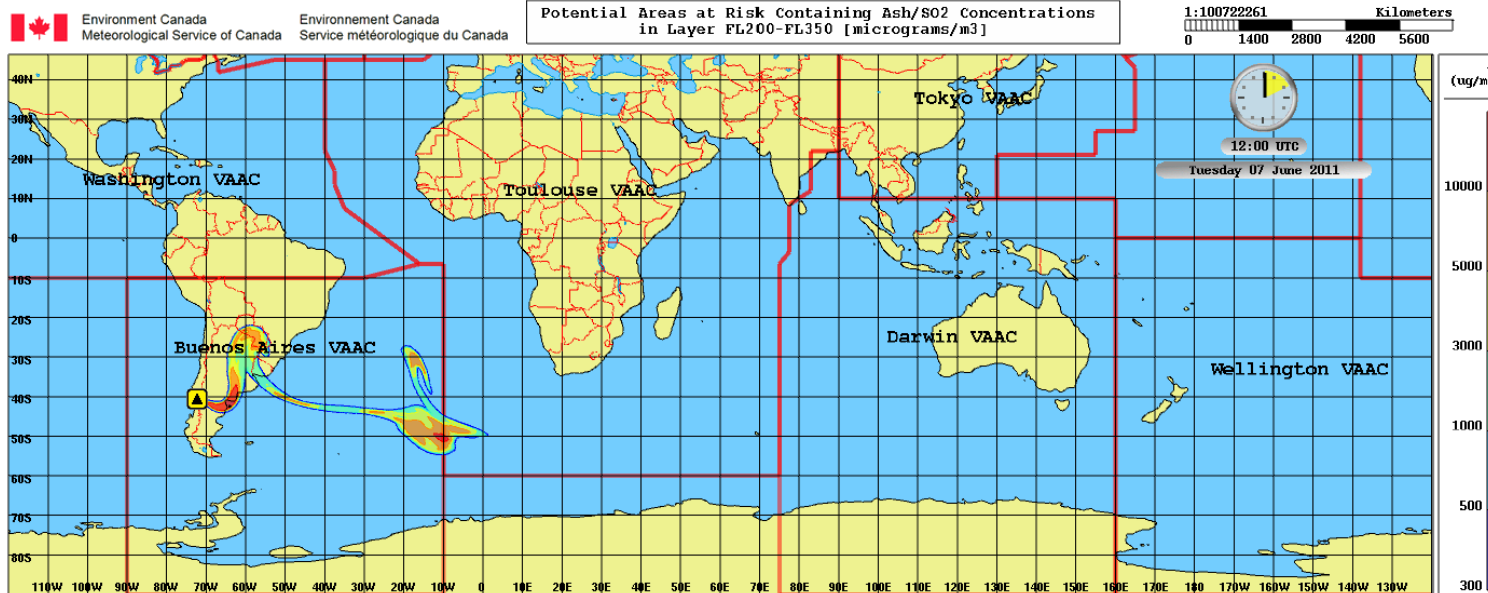
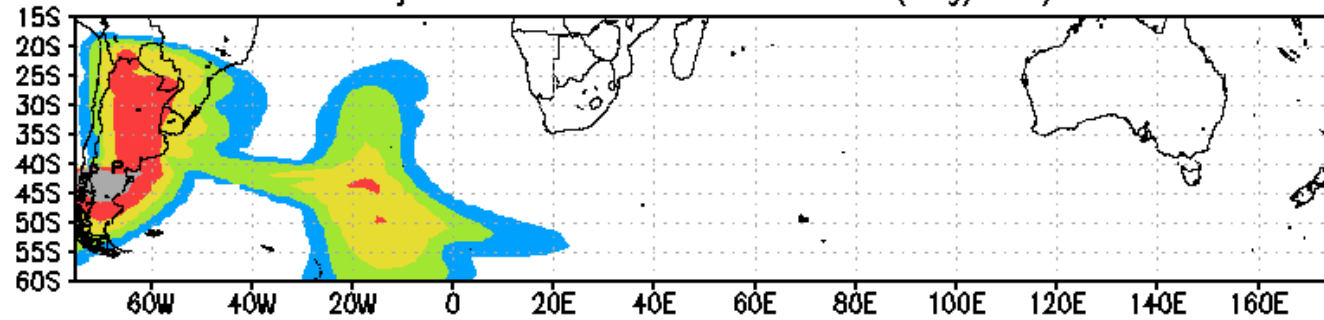
BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
05jun2011 at 12:00 FLFL250 (mg/m3)

05 Jun 12h UTC



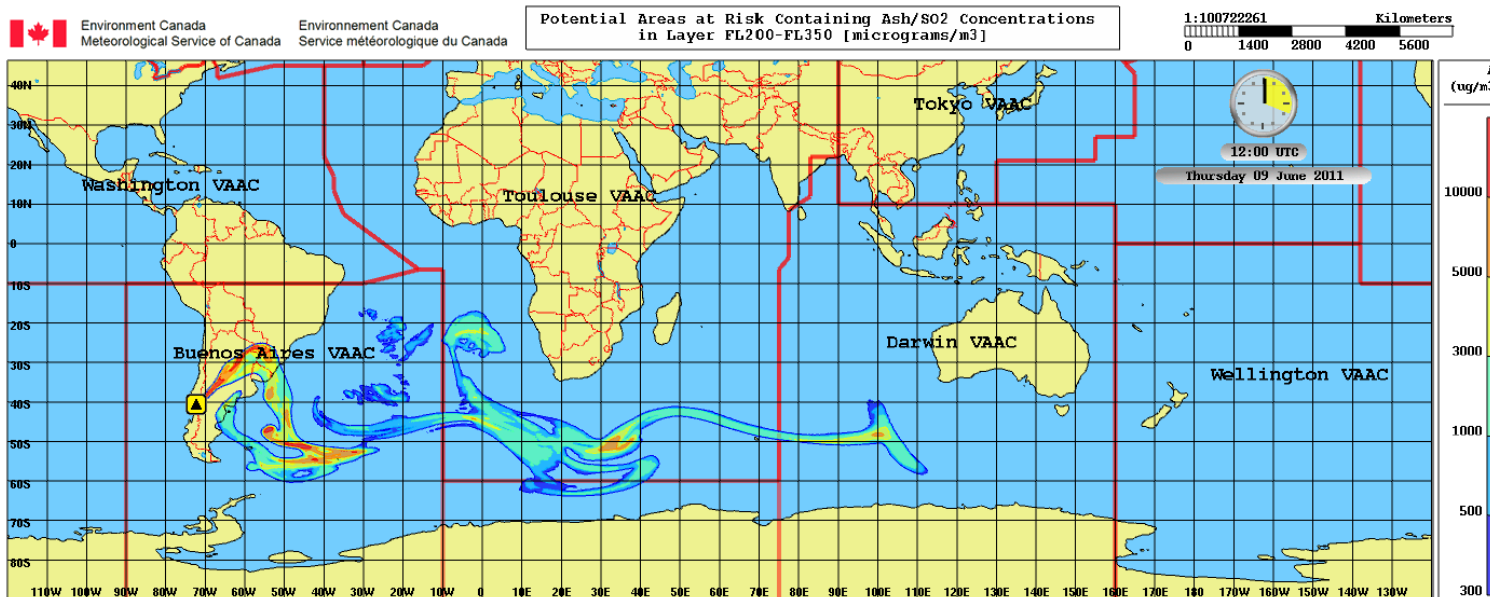
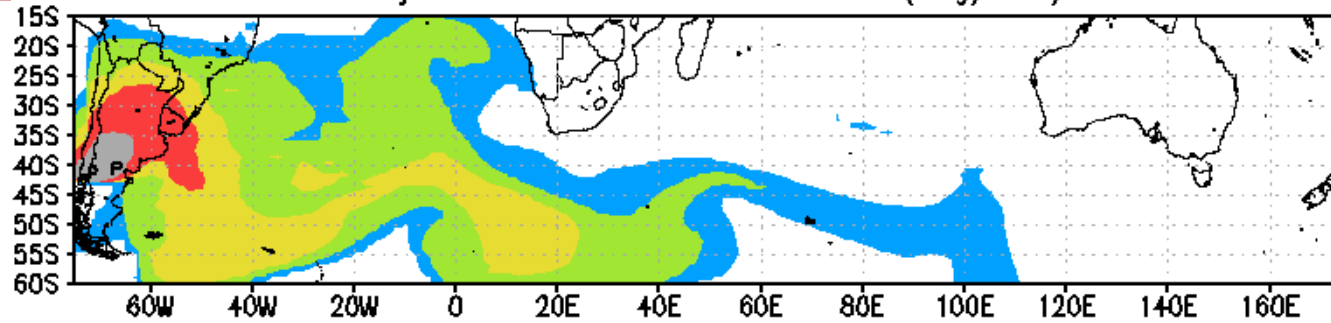
07 Jun 12h UTC

BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
07jun2011 at 12:00 FLFL250 (mg/m3)



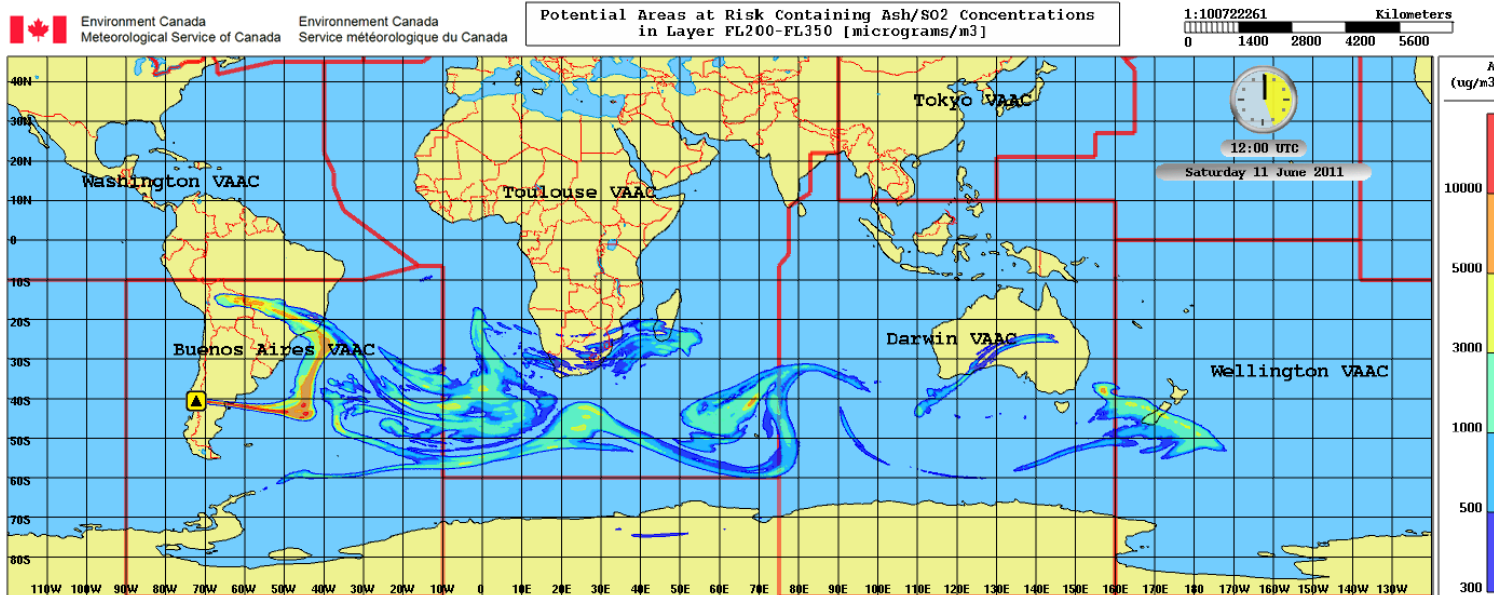
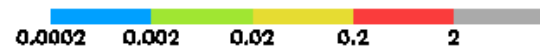
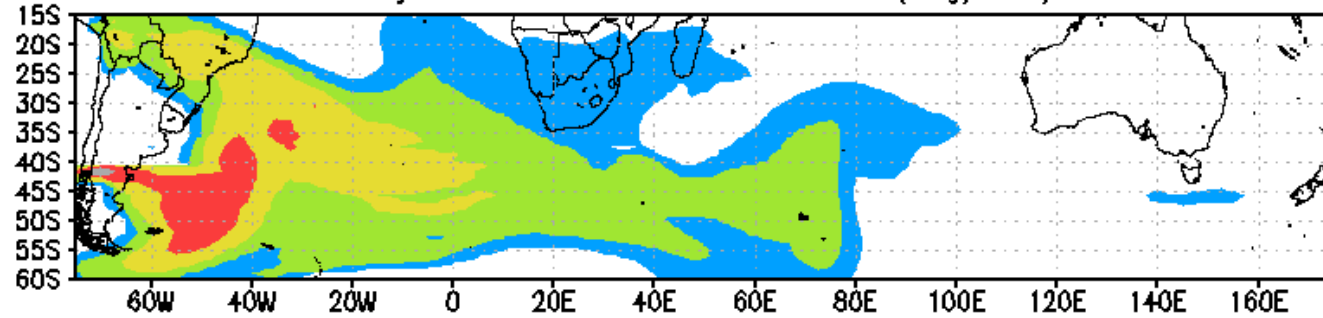
BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
09jun2011 at 13:00 FLFL250 (mg/m³)

09 Jun 12h UTC



BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
11jun2011 at 12:00 FLFL250 (mg/m³)

11 Jun 12h UTC



BSC-CNS, FALL3D-6.2 ASH DISPERSION MODEL
13jun2011 at 12:00 FLFL250 (mg/m³)

13 Jun 12h UTC

