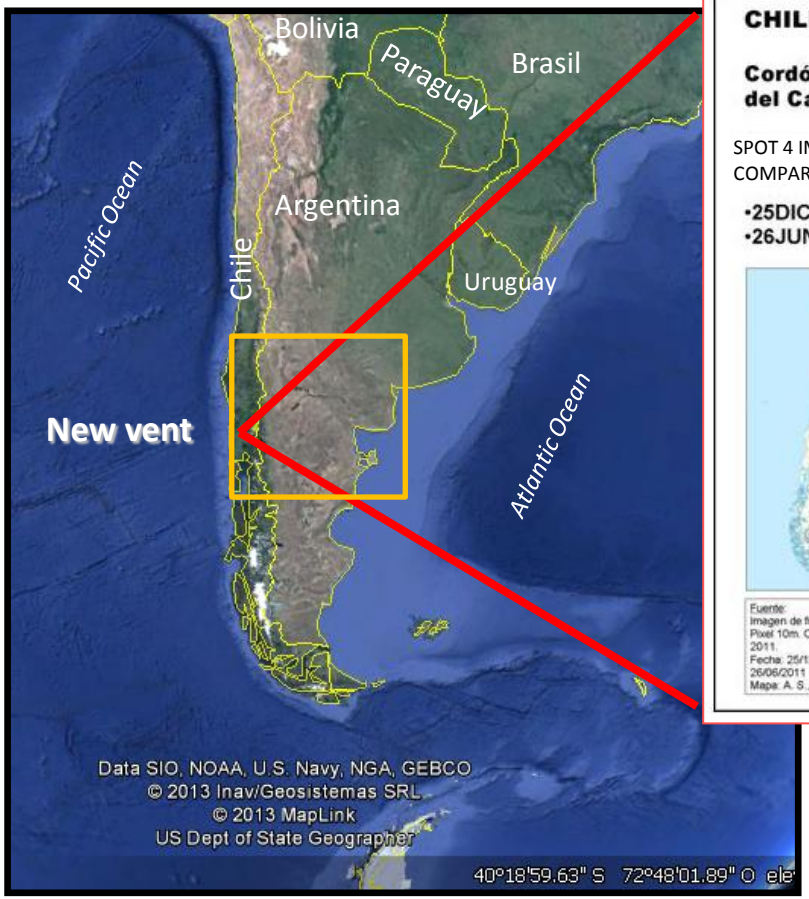
The Puyehue-Cordón Caulle re-suspended volcanic ash event

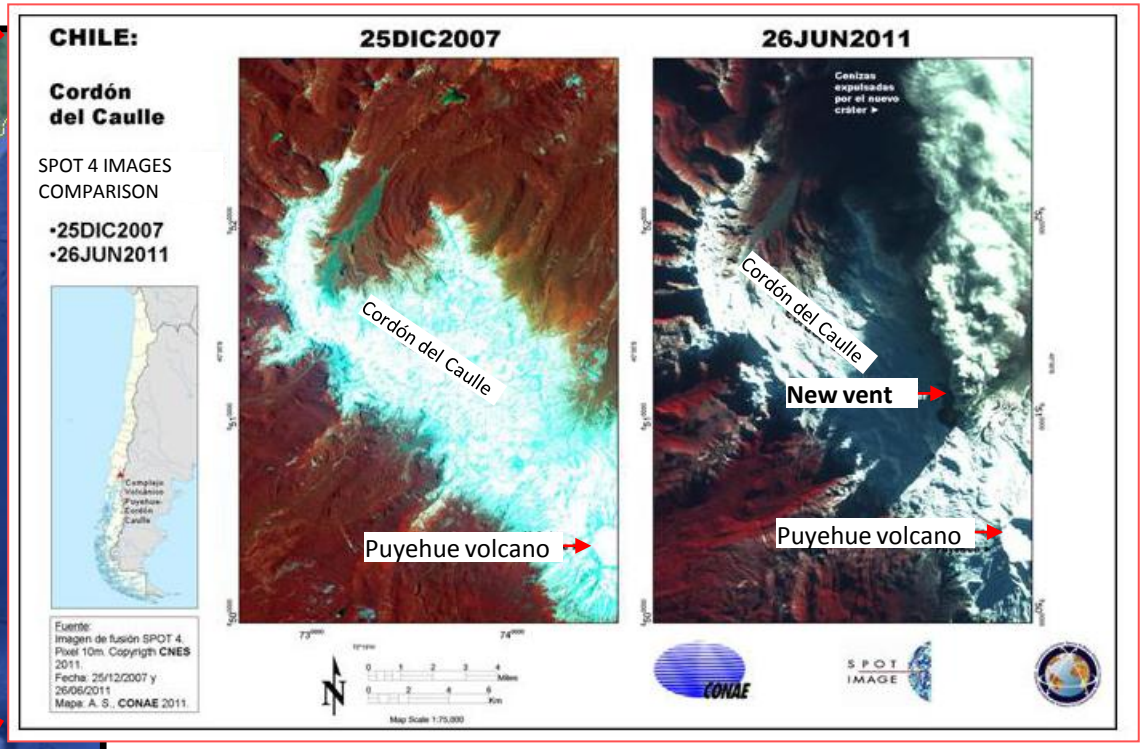
Lic. M.S Osores CONICET-CONAE-SMN

On behalf of VAAC-Buenos Aires, Argentina

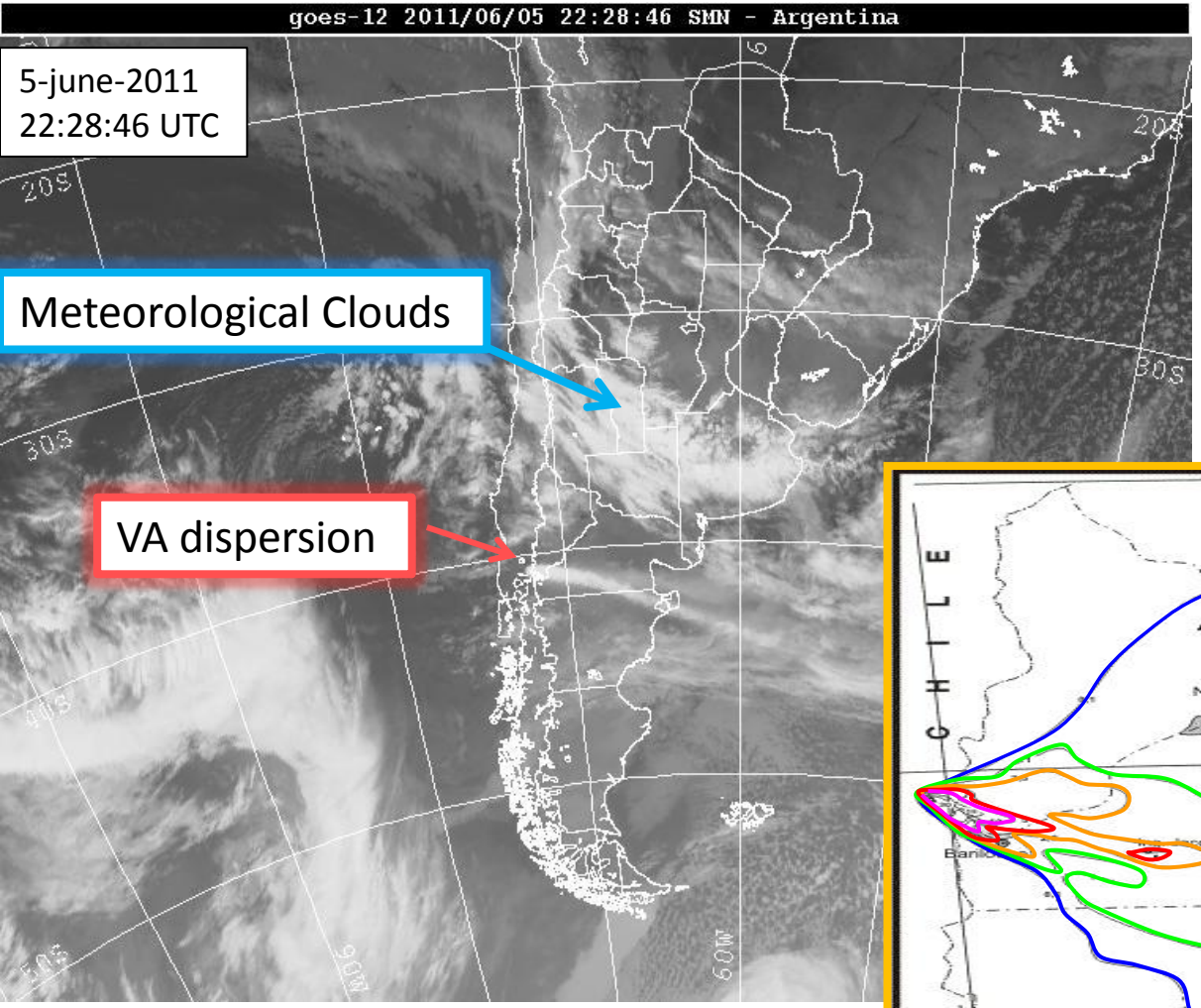
Fuente: Diario La Voz

Cordón Caulle eruption: June 2011-April 2012

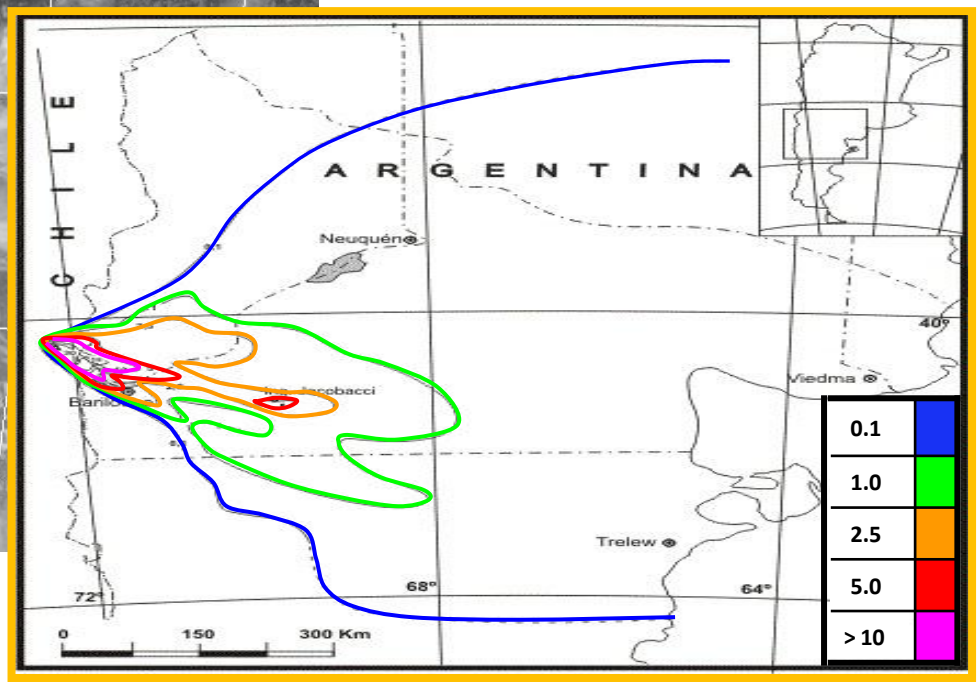




Cordón Caulle eruption: June 2011-April 2012

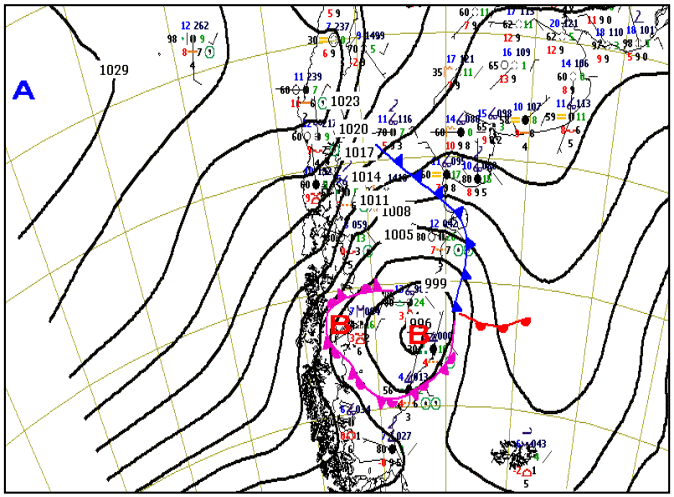


Isopach map [cm]

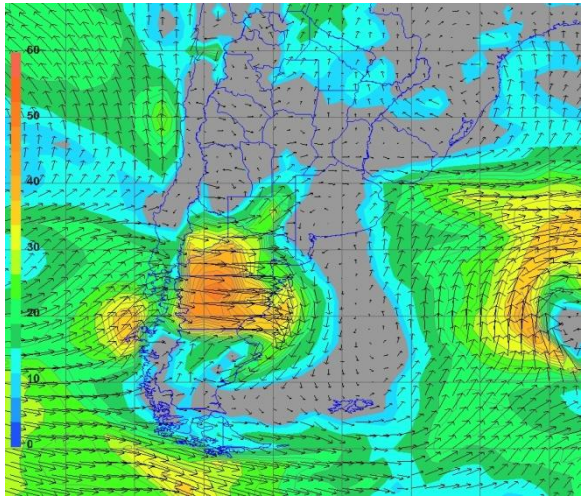


(From Collini et al., 2013)

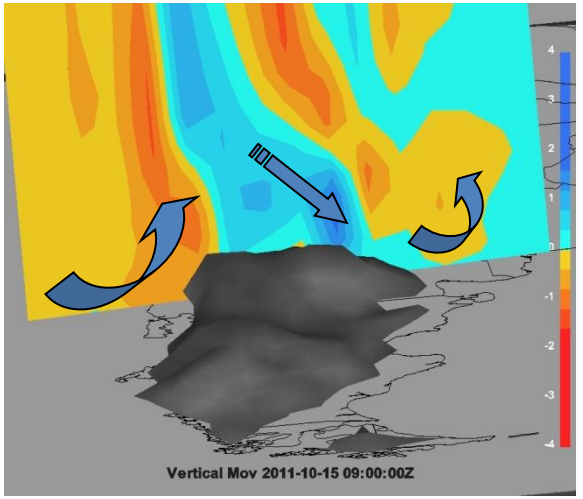
Resuspension Event: Synoptic situation – October 15-16, 2011



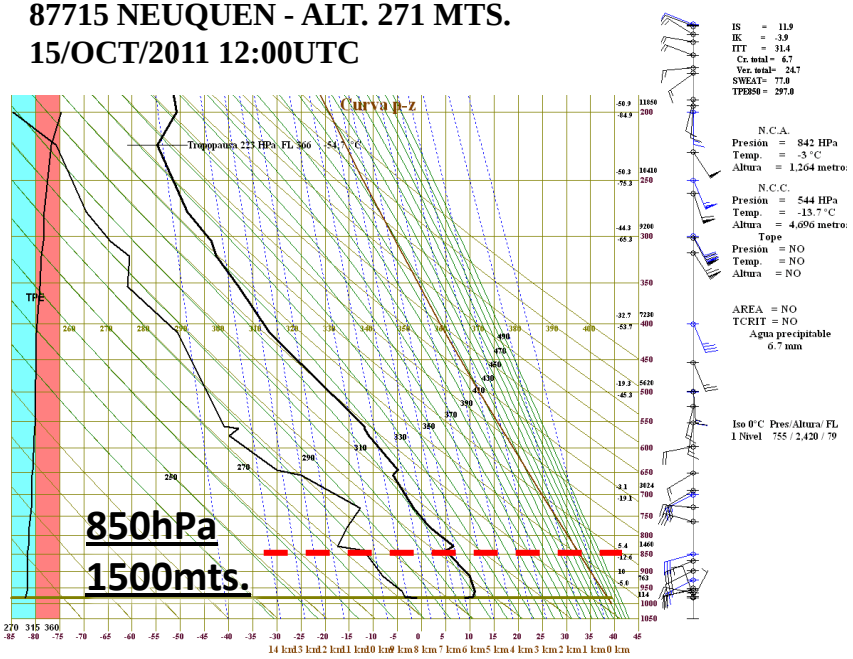
SFC OCT 15, 2011 12:00UTC

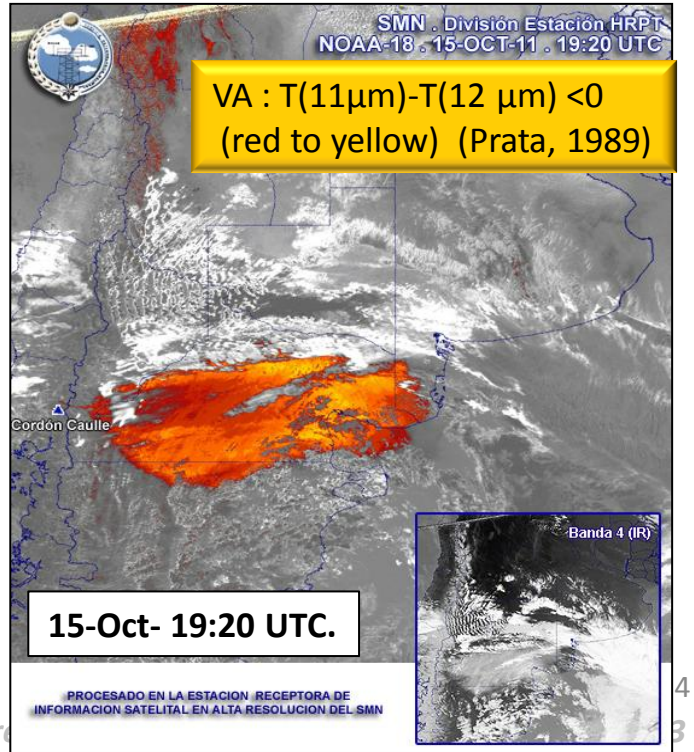


Wind Gust SFC OCT 15, 2011 12:00UTC



Vertical velocity Pa^{-1}

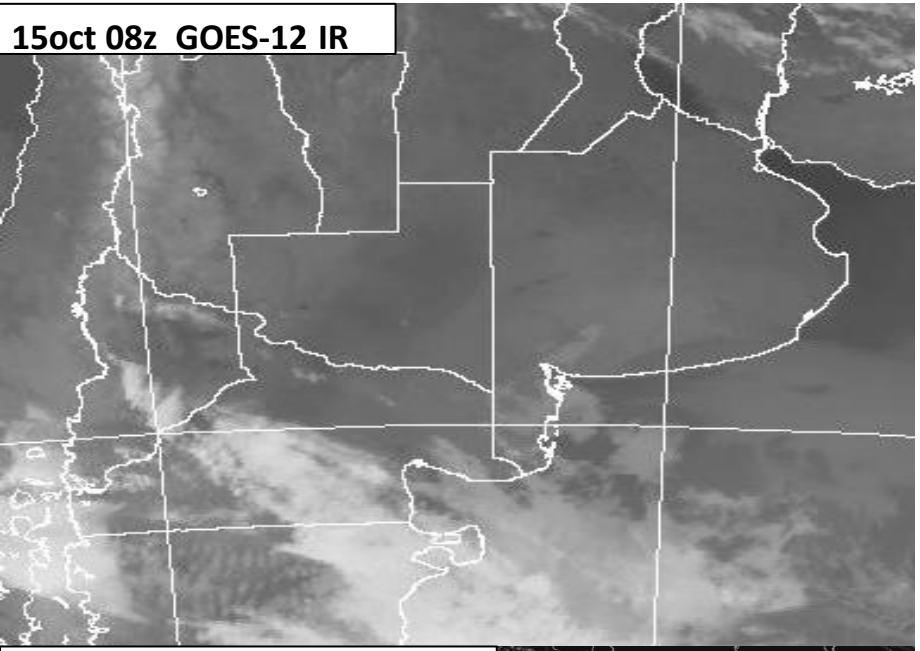




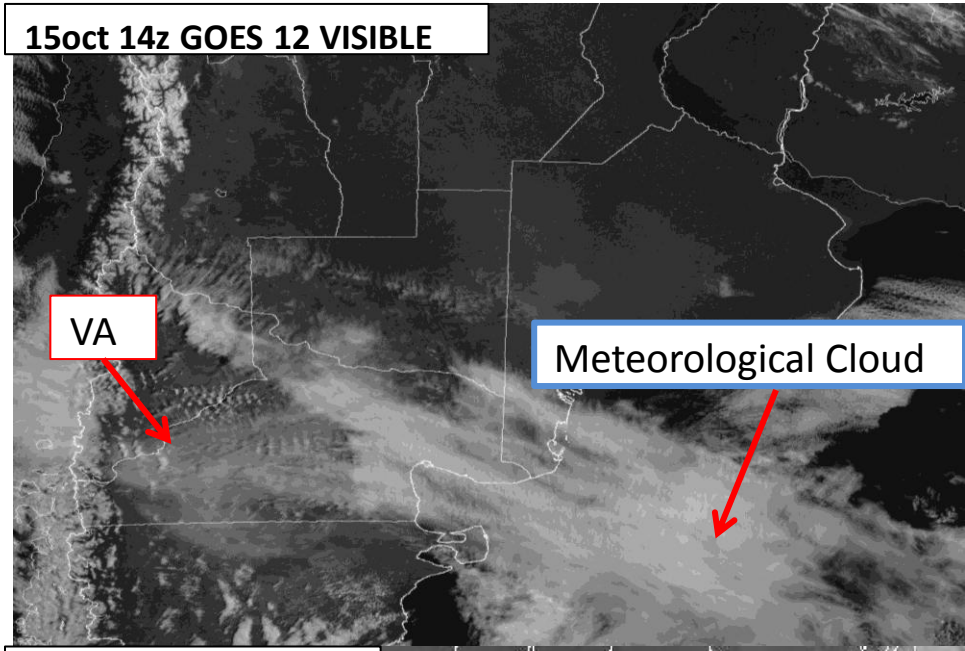
Buenos Aires VAAC – Operational Methodology for ash resuspension forecast

VA forecasts using GOES 12 (visible +IR) + GFS

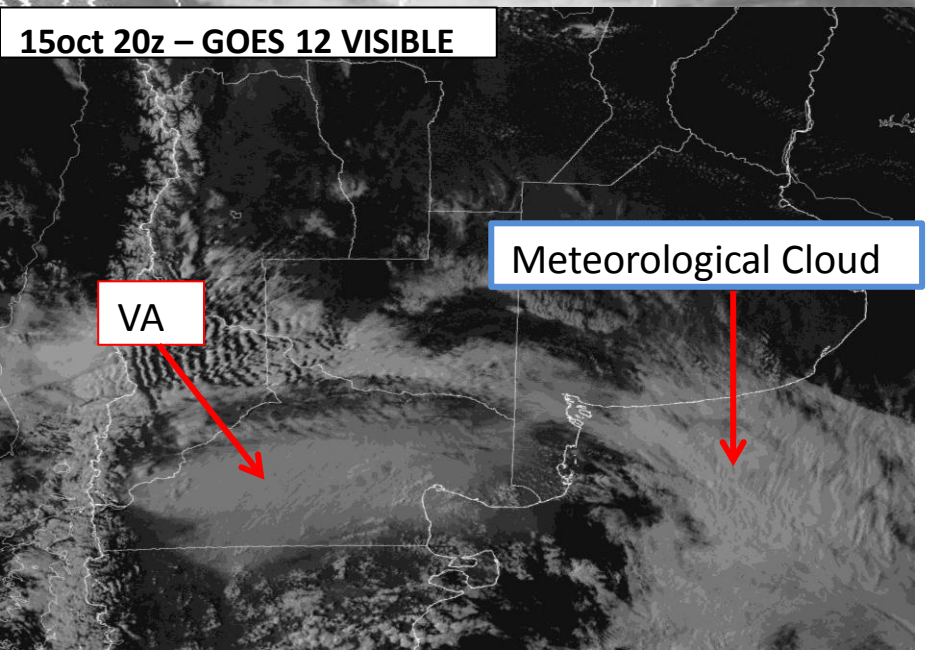
15oct 08z GOES-12 IR



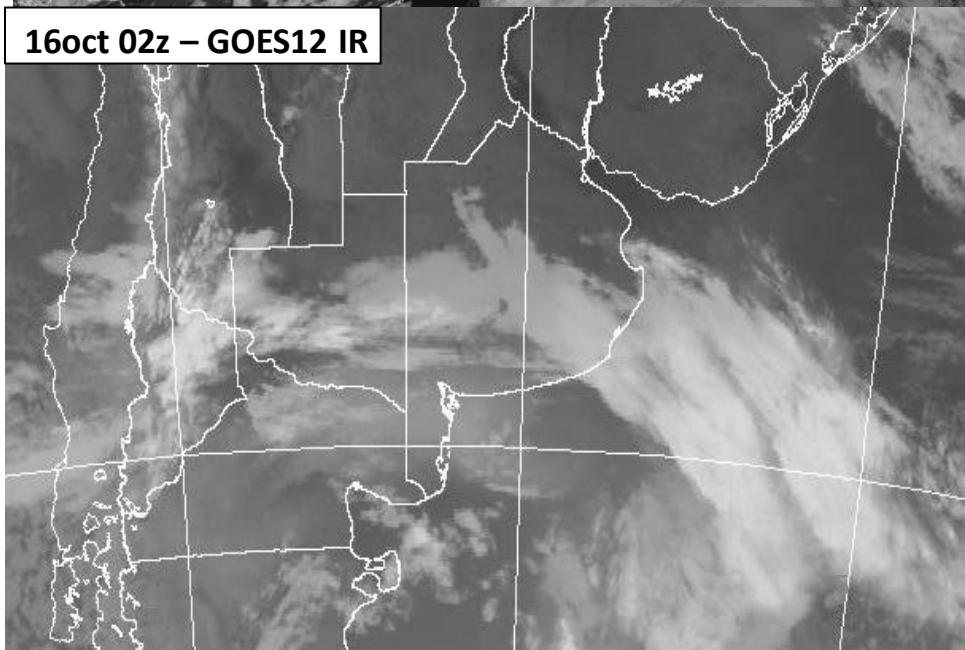
15oct 14z GOES 12 VISIBLE



15oct 20z – GOES 12 VISIBLE

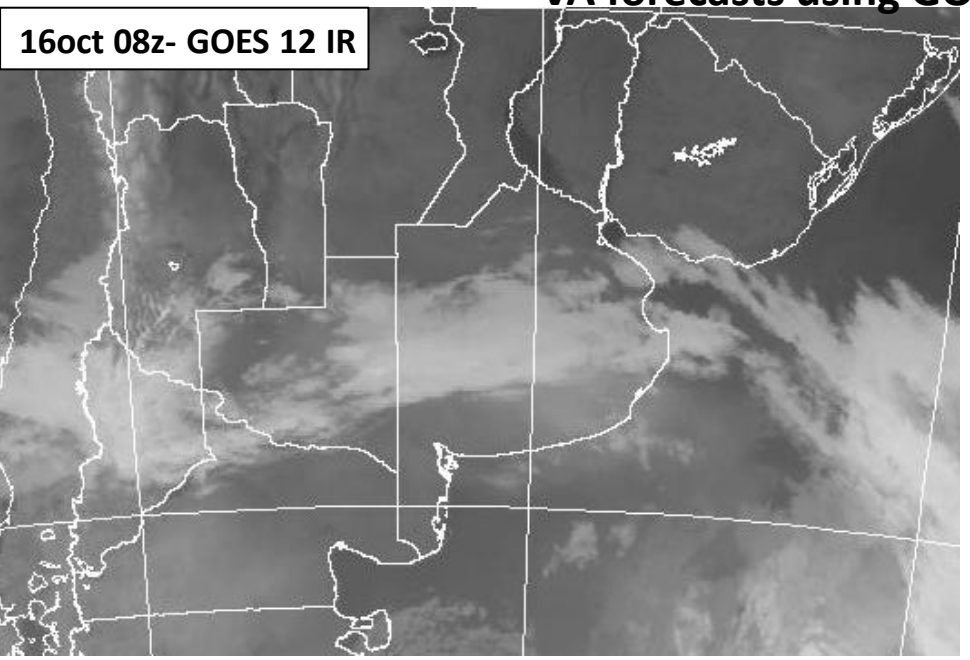


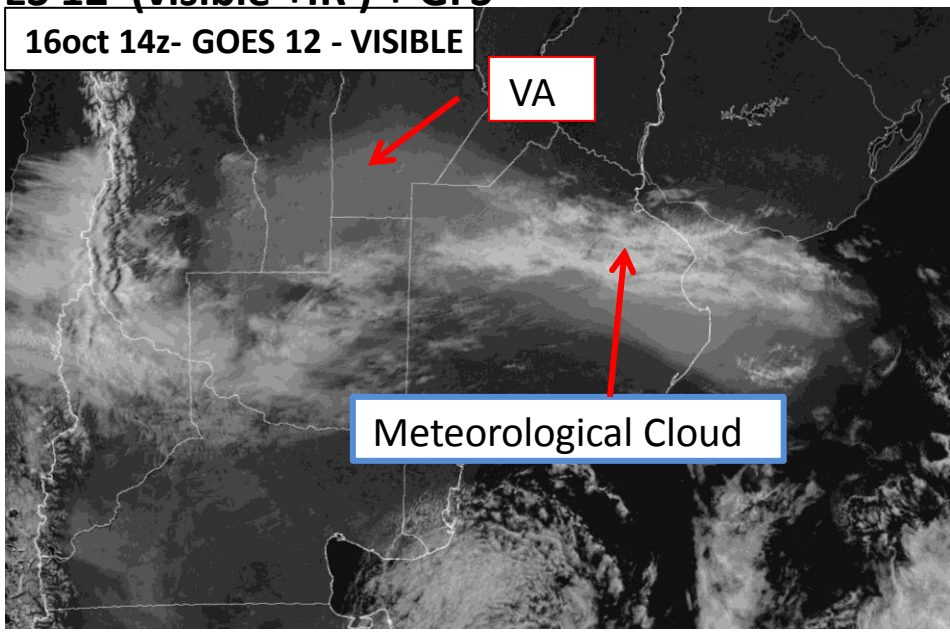
16oct 02z – GOES12 IR

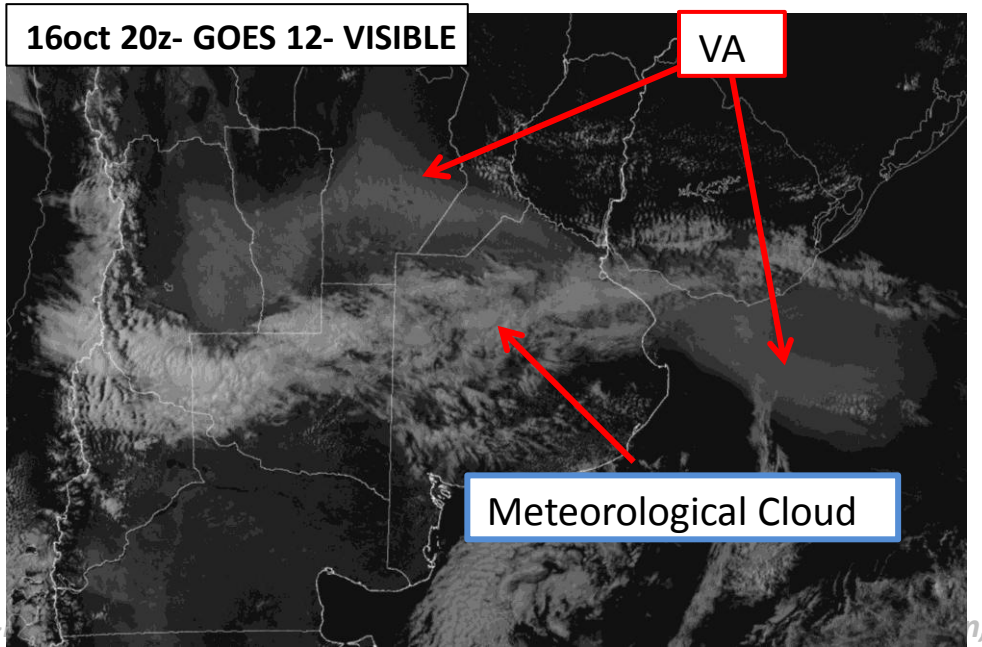


Buenos Aires VAAC – Operational Methodology for ash resuspension forecast

VA forecasts using GOES 12 (visible +IR) + GFS

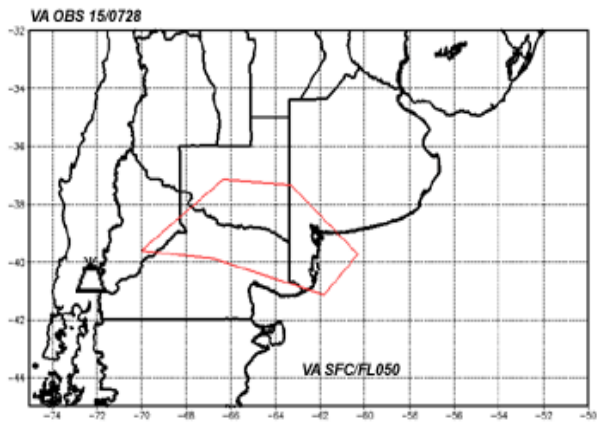






Buenos Aires VAAC – Operational Methodology for ash resuspension forecast

OBS 15-Oct-07:28 UTC



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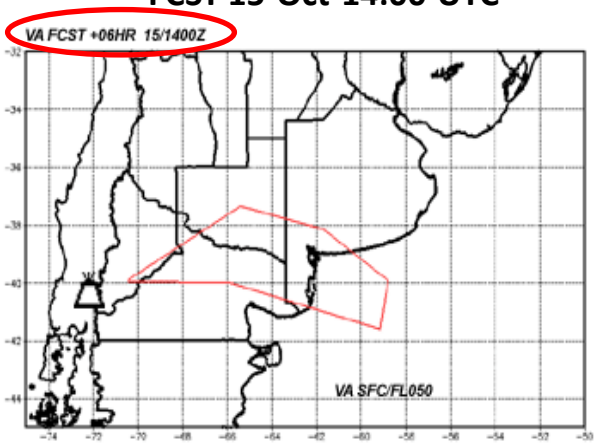

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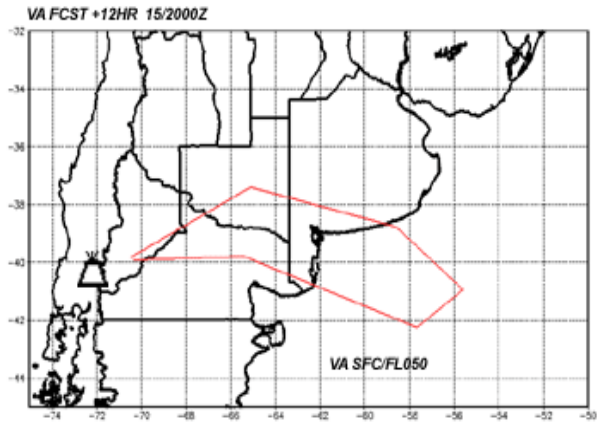

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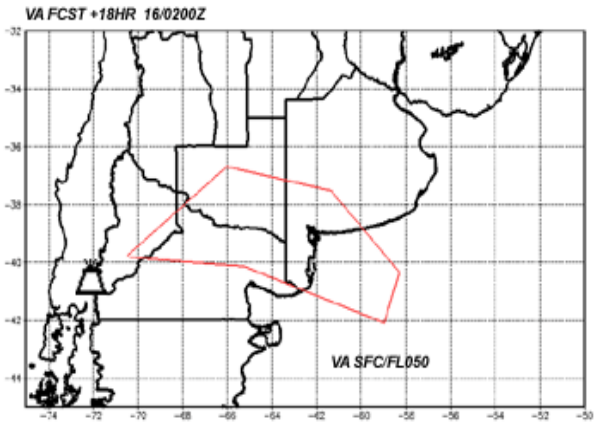
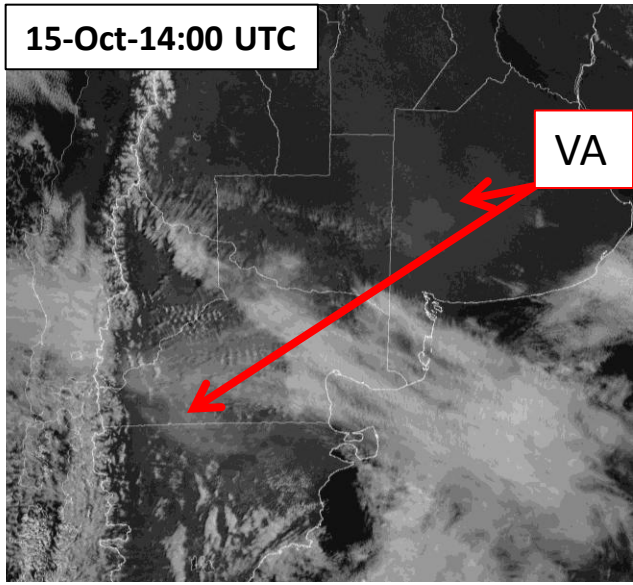


GOES 12 VISIBLE



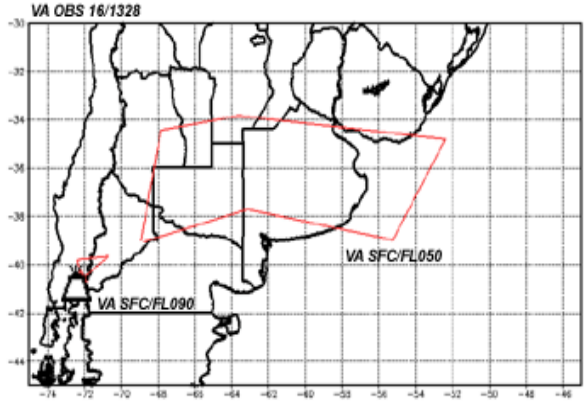
VA ADVISORY
DTG: 20111015/0800Z
VAAC: BUENOS AIRES
VOLCANO: CORDON CAULLE 1507-141
PSN: S4031 W07212
AREA: CHILE-C

SUMMIT ELEV: 1798M
ADVISORY NR: 2011/548
INFO SOURCE: GOES-12 - GFS MODEL
ERUPTION DETAILS: ONGOING EMISSIONS
OBS VA DTG: 15/0728Z

RMK: VA PLUME NOT SEEN IN SATELLITE IMAGERY DUE TO CLOUD COVER.
THE VA CLD INFORMED IS LIFTED FM SFC BY THE WIND.
CLOUD COVER MAKES DIFFICULT TO ACCURATELY DETERMINE ITS EXTENSION.
NXT ADVISORY: 20111015/1400Z

Buenos Aires VAAC – Operational Methodology for ash resuspension forecast

OBS 16-Oct-13:28 UTC



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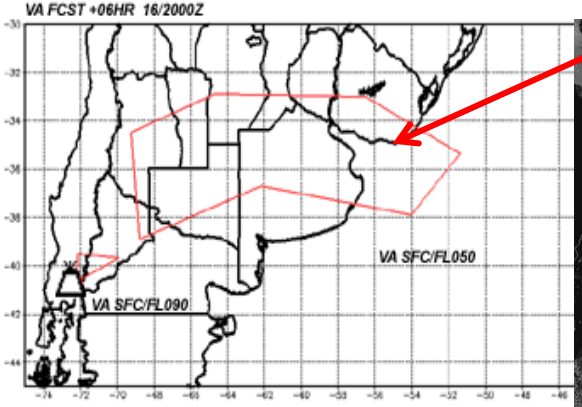
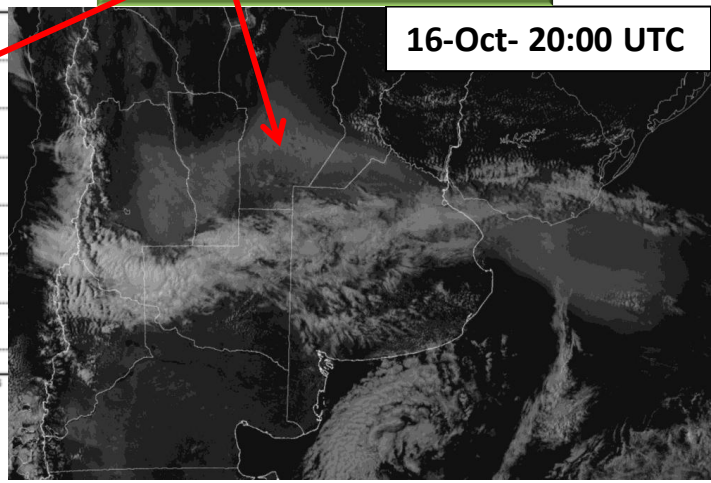


Qualitative agreement



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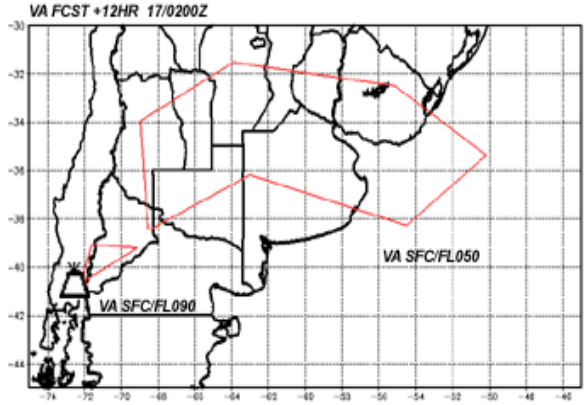

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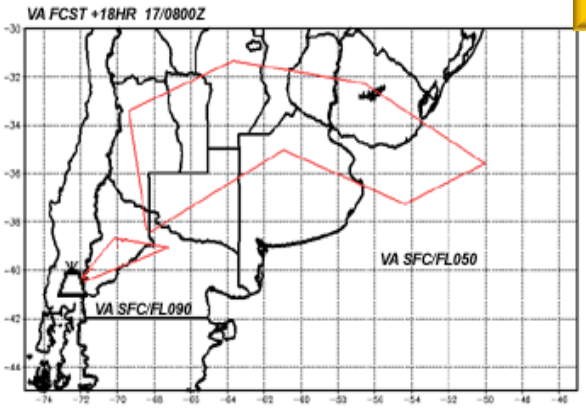
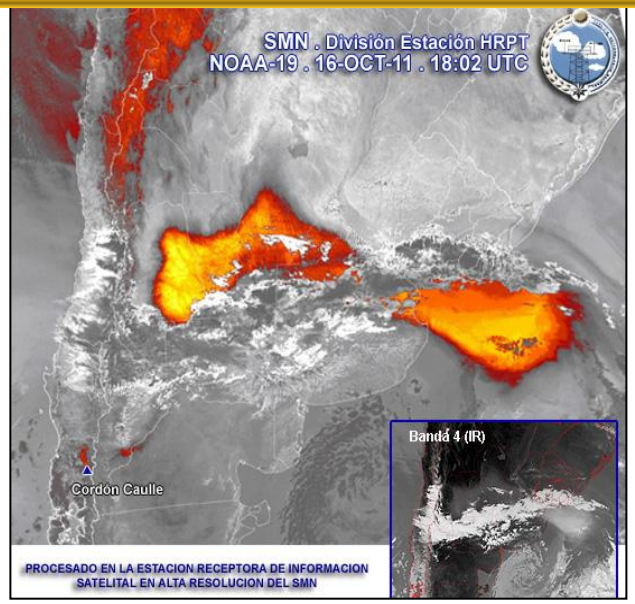


T(11µm)-T(12 µm) <0 (red to yellow) VA!!!



VA ADVISORY
DTG: 20111016/1400Z
VAAC: BUENOS AIRES
VOLCANO: CORDON CAULLE 1507-141
PSN: S4031 W07212
AREA: CHILE-C

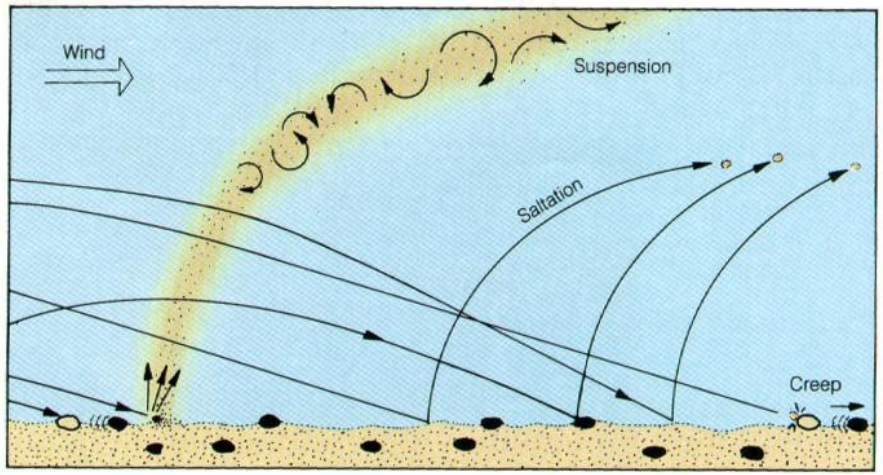
SUMMIT ELEV: 1798M
ADVISORY NR: 2011/553
INFO SOURCE: GOES-12 - GFS MODEL
ERUPTION DETAILS: ONGOING EMISSIONS
OBS VA DTG: 16/1328Z

RMK: VA CLD FROM SUMMIT CAN BE IDENTIFIED IN SATELLITE IMAGERY.
THE ANOTHER VA CLD INFORMED IS LIFTED FM SFC BY THE WIND. CLOUD COVER MAKES DIFFICULT TO ACCURATELY DETERMINE ITS EXTENSION.
NXT ADVISORY: 20111016/2000Z

Buenos Aires VAAC – Research collaboration

Motivated by this event, a multidisciplinary group of researchers from BSC-CNS (Spain), CONICET, SHN, CONAE (Argentina) in collaboration with the SMN, tested and validate three different emission schemes in the FALL3D-7.0 model (Costa et al., 2006, Folch et al., 2009). The final goal of this work is the implementation as an operational forecast product for VAAC-Buenos Aires. This work is under review at NHESS.

- How is resuspension triggered ?
- Soil erosion when $u_* < u_{*_t}$, depends on:
  - Properties of soil particles
  - Soil moisture and roughness.



http://www.geol.umd.edu/

Emission Schemes for Mineral Dust

Emisison scheme 1:
(Wesphal et al., 1987)

$$F_V = \begin{cases} 0 & u_* < u_{*t} \\ 10^{-5} u_*^4 & u_* \geq u_{*t} \end{cases}$$

Emission scheme 2:
(Marticorea et al ,1997)

$$F_V(d) = \begin{cases} 0 & u_* < u_{*t}(d) \\ \dfrac{K \rho_a u_*}{g} \left(u_*^2 - u_{*t}^2(d)\right) & u_* \geq u_{*t}(d) \end{cases}$$

Emission scheme 3:
(Shao and Lu, 2000)

$$F_V(d) = \sum_{d_s=d}^{d_s=d_{max}} \frac{\alpha(d, d_s)}{u_{*t}^2(d)} p(d_s) F_H(d_s)$$

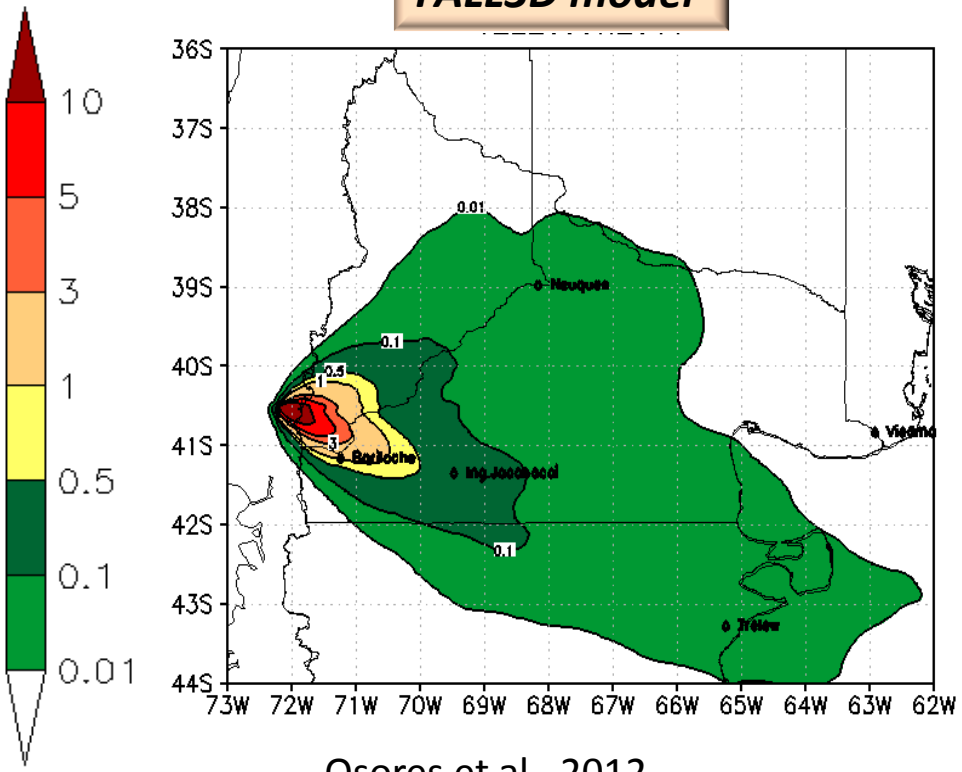
$$F_H(d_s) = \begin{cases} 0 & u_* < u_{*t}(d_s) \\ c_o \frac{\rho_a u_*^3}{g} \left(1 - \frac{u_{*t}^2(d_s)}{u_*^2}\right) & u_* \geq u_{*t}(d_s) \end{cases}$$

Modeling Strategy

Source: Preliminary WRF-ARW/FALL3D simulation (4-20 June 2011)
TGSD: estimated from field data.
Meteorological model: WRF-ARW with 12 km of horizontal resolution, 38 vertical levels and 3 hours results
FALL3D 7.0 model: 0.1 º of horizontal resolution and 14 vertical levels up to 4 km.

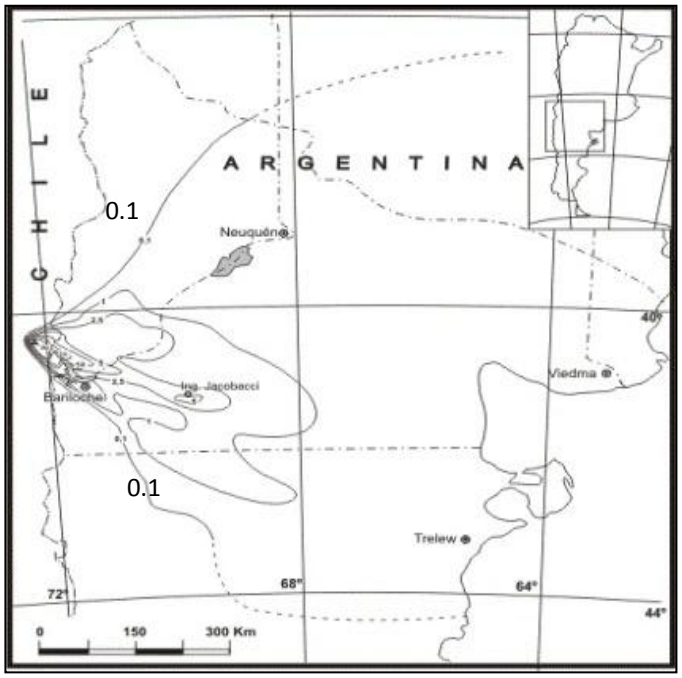
Isopach maps [cm]

FALL3D model



Osores et al., 2012

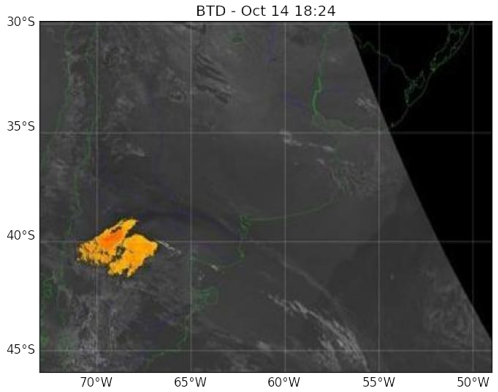
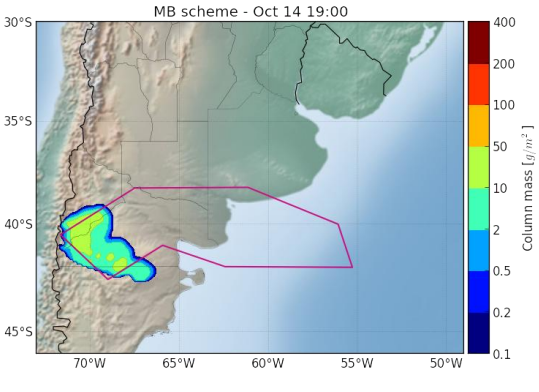
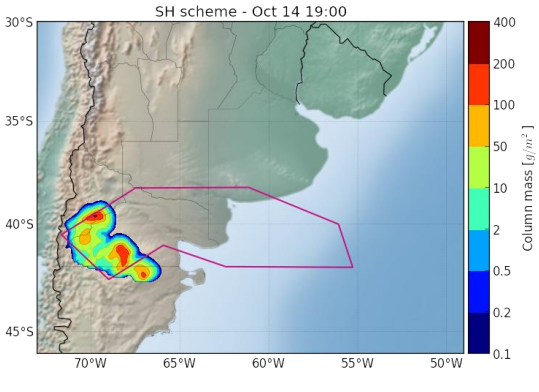
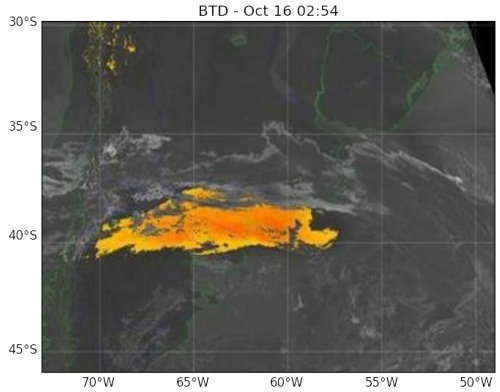
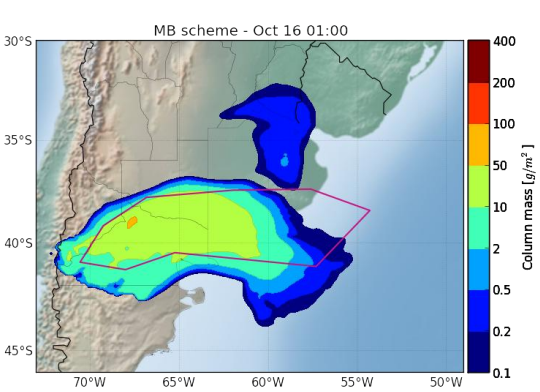
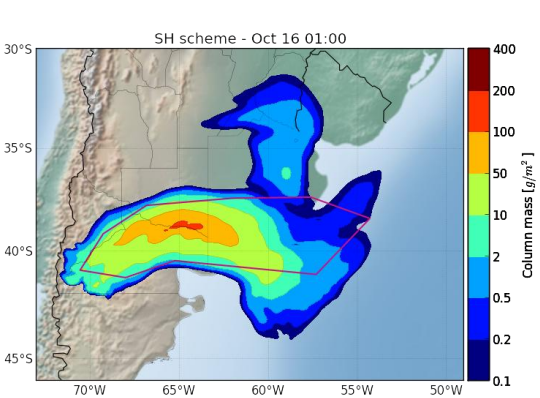
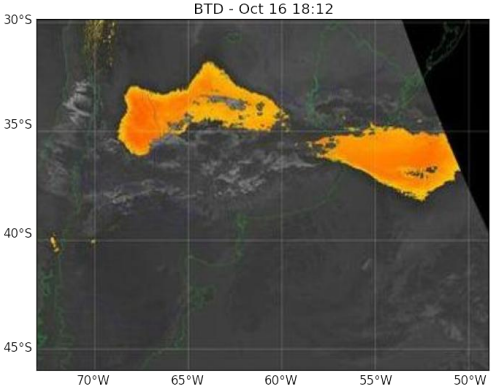
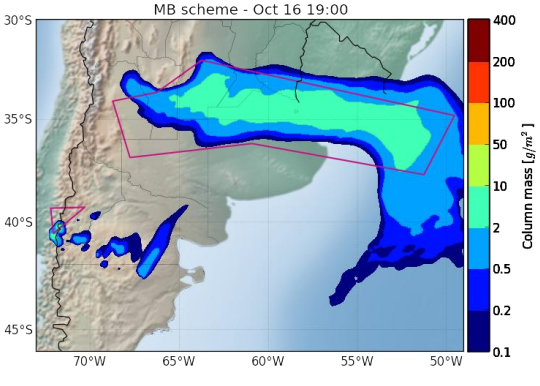
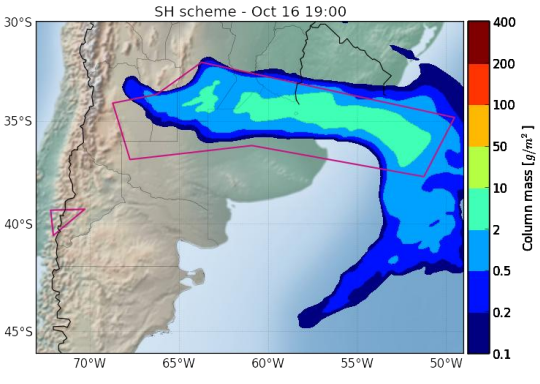
Reconstructed from field data



Collini et al., 2013

Buenos Aires VAAC – Research collaboration

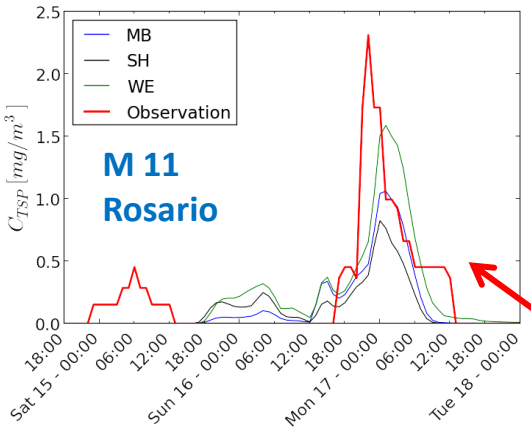
Qualitative model validation

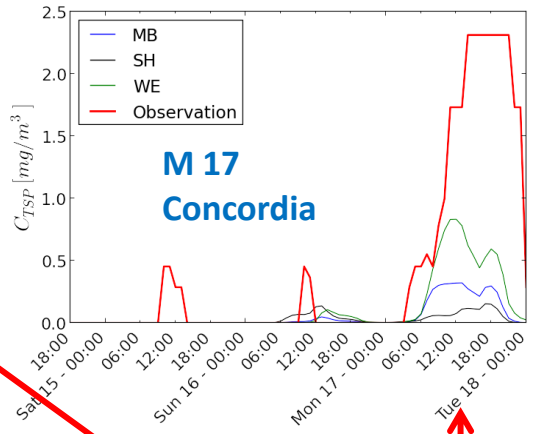
BTD Modis images	MB: Mass Load[g/m2]+VAG	SH: Mass Load[g/m2]+VAG
		
		
		

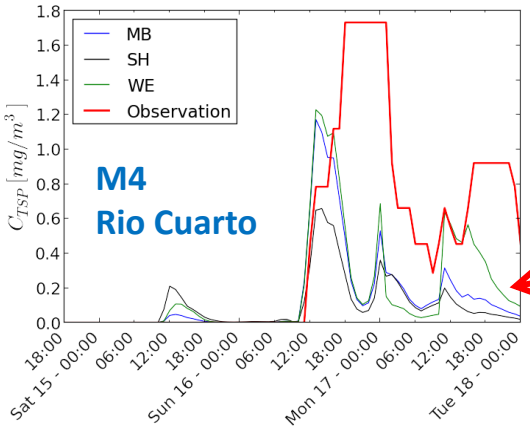
Qualitative model validation

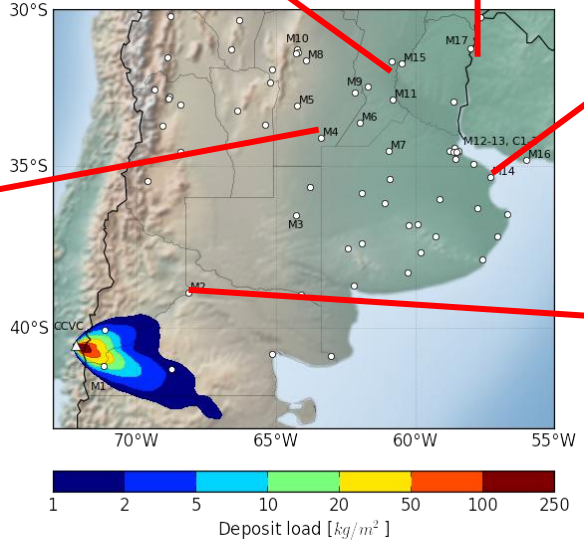
CTSP (Shao et al, 2003) infered from visibility at ~40 meteorological stations from SMN

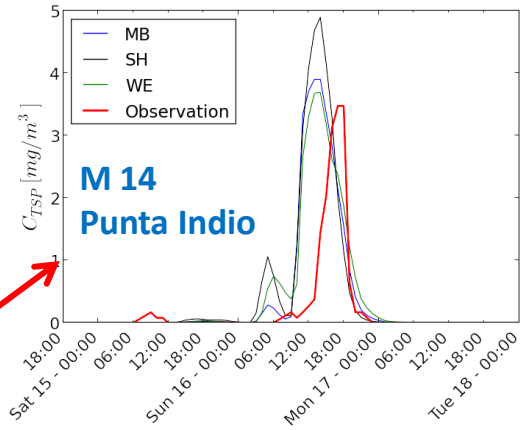
$$C_{TSP} = \begin{cases} 3802{,}29D^{-0{,}84} & D < 3{,}5\ km \\ \exp(-0{,}11D + 7{,}62) & D \geq 3{,}5\ km \end{cases}$$

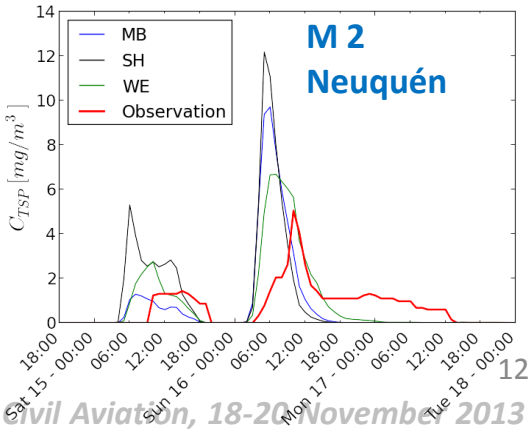












Buenos Aires VAAC – Conclusions

- Since this major resuspension event, Buenos Aires VAAC watches the area of deposit as well as the volcanic source region using the remote sensing technology and scientific contributions such as isopach maps. Also Modis BTD images are operatively supplied by CONAE.

- After overcome the FALL3D-7,0 model evaluation stage, we expected to implement it operatively for future resuspension events.