Validation of GOES-R volcanic ash products: near real-time operational decision support/hazard analysis

P. W. Webley[1], M. Stuefer[1], J. Dehn[1], T. Steensen[1], S. Egan[2], M. Pavolonis[3], and G. Grell[4]

1. Geophysical Institute, University of Alaska Fairbanks, Fairbanks. AK
2. Dept. of Chemistry, University of Alaska Fairbanks, Fairbanks. AK
3. NOAA/NESDIS, Madison, WI
4. NOAA ESRL, Boulder, CO

Topics: Severe Weather

Program: GOES-R3

2. Introduction

- GOES-R is a key element in NOAA's ongoing satellite series. We provide a confirmation, validation and assessment of one of the GOES-R baseline products.

- Provide tools to better understand the outputs of effective particle size, volcanic ash mass and height from the volcanic ash cloud detection and height algorithm.

- Volcanic ash clouds are a severe event and can cause serious damage to aircraft, cause airport closures and affect human health.

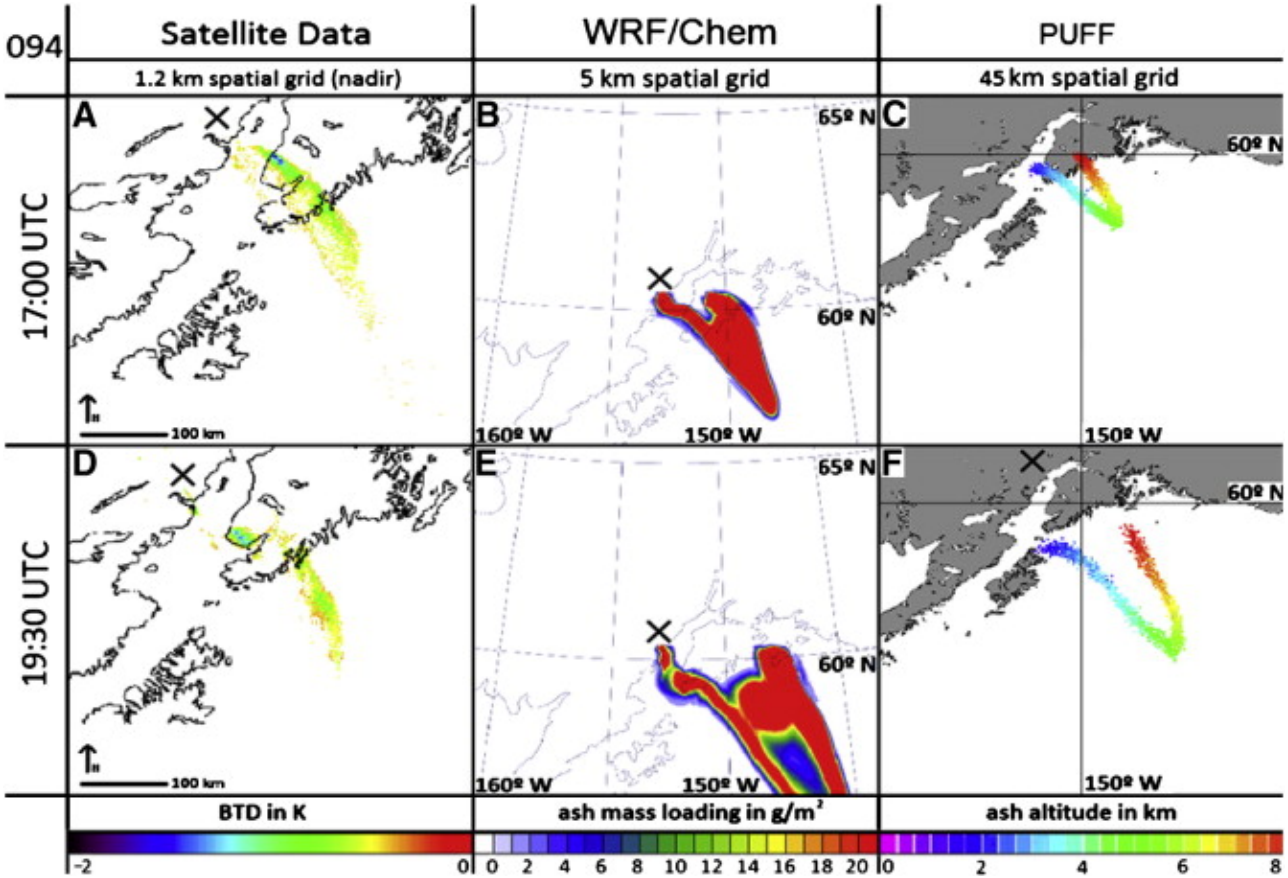
- The work aims to provide improved hazard assessment and reduce the potential risk from volcanic eruptions. Develop a coupled model and demonstrate its operational capabilities.

3. Methodology/Expected Outcomes

- Produce a WRF-Chem/Puff model-satellite comparison product for operations
- Provide a confirmation and an assessment of GOES-R derived ash cloud detections and heights
- Determine the full particle size distribution and total mass and relate to retrieved GOES-R products
- Create an operational volcanic ash dispersion product for NWS

4. Results

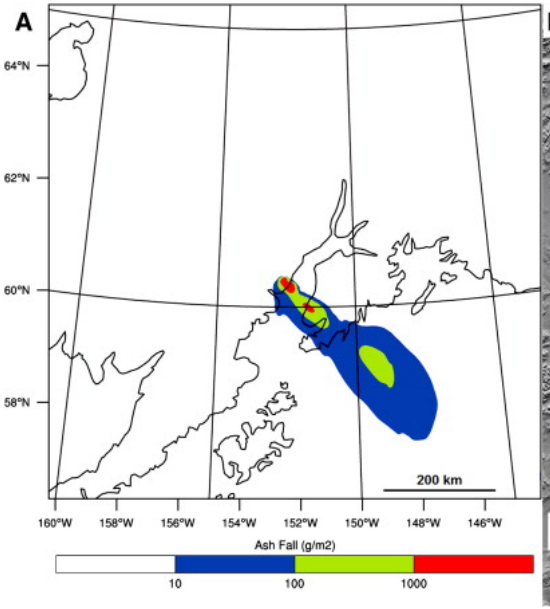
- Redoubt 2009 events
- Qualitative comparison
- Volcanic Ash v Puff VATD v WRF-Chem VATD

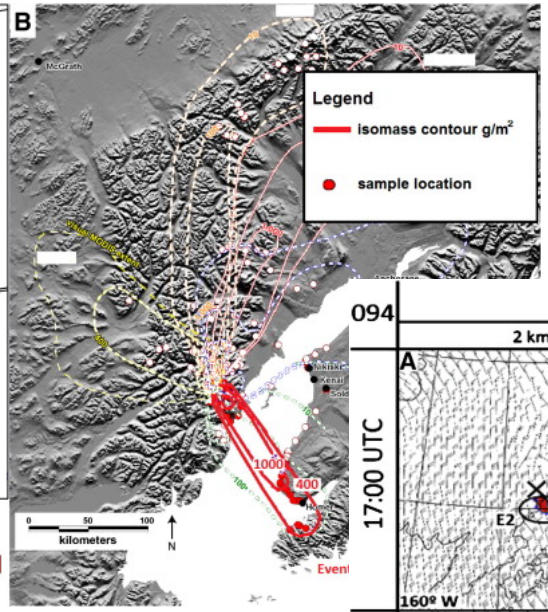


Satellite
V
WRF-Chem
V
Puff VATD

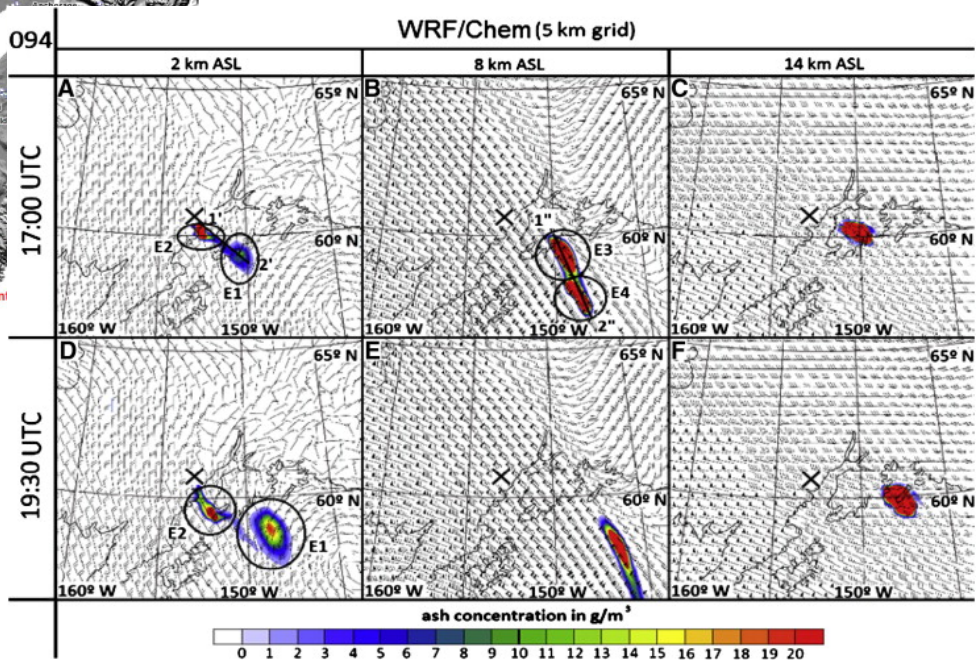
4. Results

- Significant to get PSD, MER and height accurate
- How to compare quantitatively?





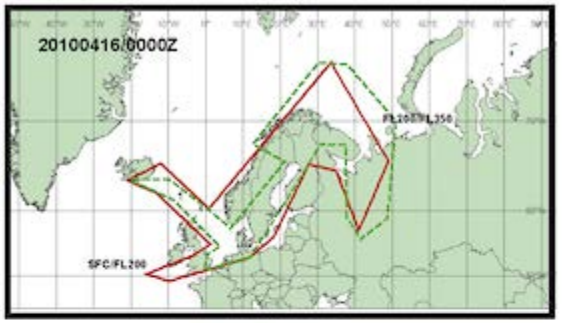
Spatial resolution of model domain?



Ashfall mapping

4. Results

- Eyjafjallajökull 2010
- April 14 – 19 period
- Plume top heights from radar
- Satellite data from SEVIRI



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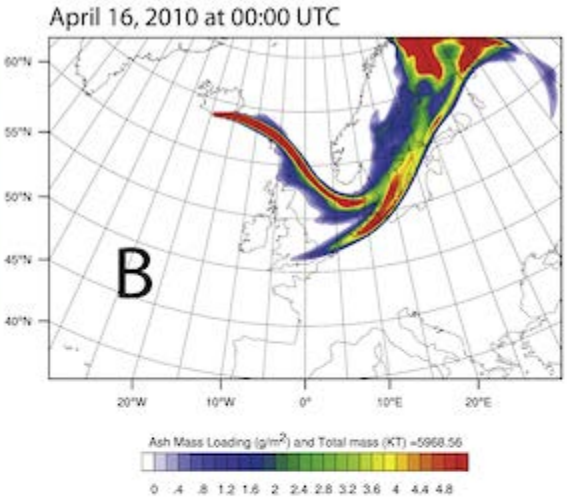
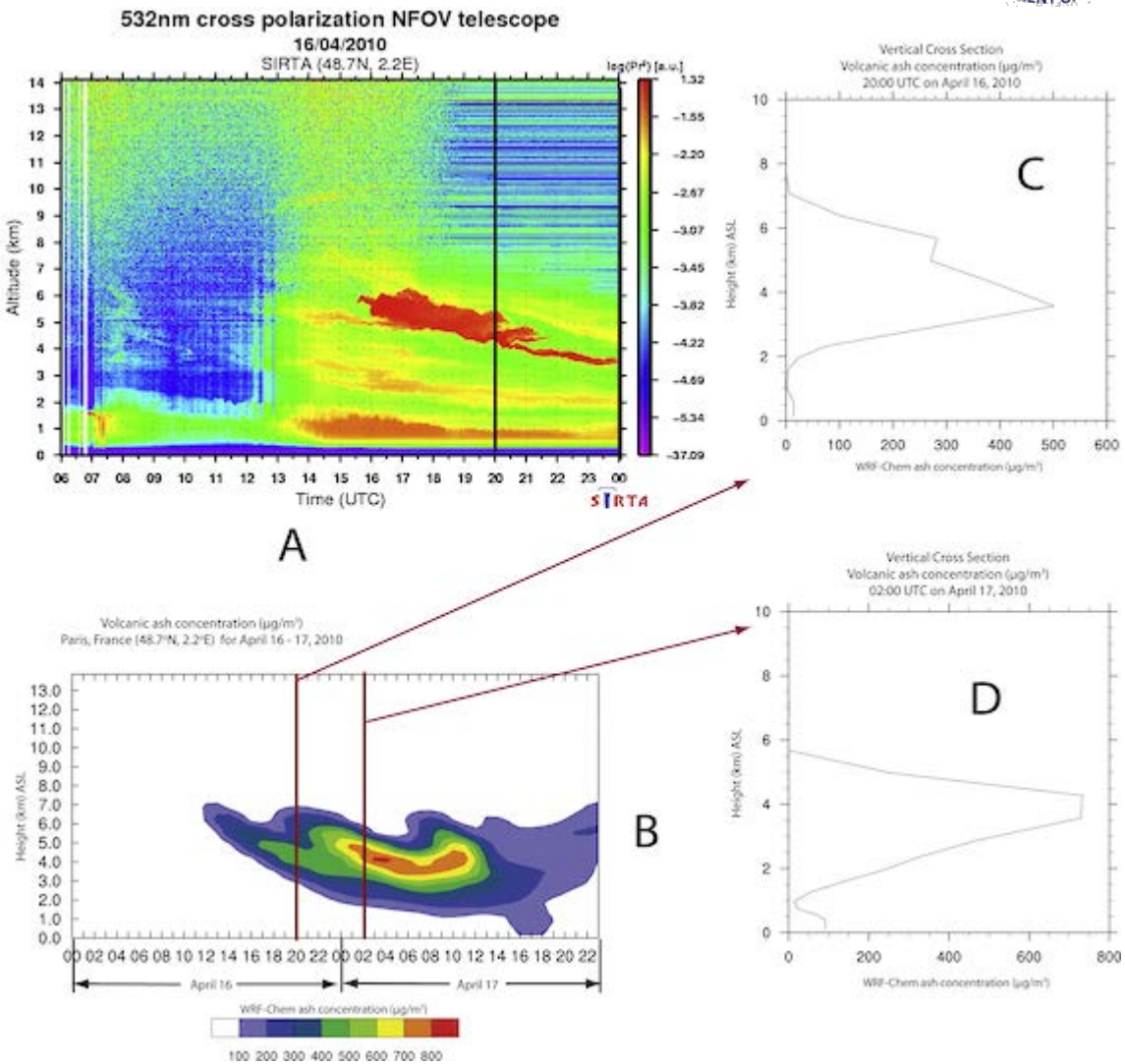


4. Results

- Showed good agreement in space and time to LIDAR
- Similar orders of magnitude when compared to the post-processed LIDAR concentrations
- Significance of initial MER and fine ash content



5. Possible Path to Operations

- Scheme for volcanic WRF-Chem model in operational setting in development.

- Goal: WRF-Chem 48 hour ash/SO_2 prediction available within 30 minutes of an actual eruption.

- Pre-define model domains, and run the WRF Preprocessing System (WPS) operationally whenever initial and boundary meteorological data become available.

- Three domains will be centered on main active volcanoes within the responsible area of the Alaska Volcano Observatory, the Anchorage VAAC, and volcanoes of the Trans-Mexican volcanic belt for the Washington VAAC. The domains will be well within GOES-R coverage.

- WRF-Chem runs will be initiated automatically once a GOES-R volcanic ash product is received (i.e. email).

6. Future Plans

- Sarychev Peak 2009 and Kasatochi 2008 qualitative comparison between satellite and model
- Continued SO_2 analysis, compare to AWG SO_2 and other NOAA/NASA data
- WRF-Chem re-initialize off satellite data
- WRF-Chem pre-event forecasting and then satellite height and mass loading for NRT
- VIIRS ash detection and comparison to WRF-Chem and other VATD models

7. Publication List

- <u>Project Publications – Part I (Published)</u>

- Steensen, T., and Webley, P., (2012). Qualitative analysis of input parameter for satellite-based quantification of airborne volcanic ash. *IGARRS 2012. 4pgs.*

- Behnke, S. A., Thomas, R. J., McNutt, S. R., Schneider, D. J., Krehbiel, P. R., Rison, W., and Edens, H. E., (2012). Observations of Volcanic Lightning during the 2009 Eruption of Redoubt Volcano. J. Volcanol. Geotherm. Res., doi:10.1016/j.jvolgeores.2011.12.010.

- Webley, P. W., Steensen, T., Stuefer, M., Grell, G., Freitas, S and Pavolonis, M., (2013). Analyzing the Eyjafjallajökull 2010 eruption using satellite remote sensing, lidar and WRF/CHEM dispersion and tracking model. *Special Issue of Journal of Geophysical Research: Eyjafjallajökull 2010 eruption*, ***doi:10.1029/2011JD016817***

7. Publication List

- <u>Project Publications – Part II (Press/Review)</u>

- Ekstrand, A. Webley, P. W., Nelson, D. L., Garay, M. J., Dehn, J., Steensen, T. S., Dean, K. D., and Prakash, A., (2013). A Multisensor Plume Height Analysis of the 2009 Redoubt Eruption. *J. Volcanol. Geotherm. Res : SI on 2009 Redoubt Eruption, eds. Peter Webley and Chris Waythomas,* ***In Press***

- Steensen, T., Stuefer, M., Webley, P. W., Grell, G., and Freitas, S., (2013). Analysis of Ash Distribution of the Redoubt 2009 Eruption based on Satellite Observations and Model Estimates*. J. Volcanol. Geotherm. Res: S.I. on 2009 Redoubt Eruption, eds. Peter Webley and Chris Waythomas,* ***In Press***

- Stuefer, M., Freitas, S. R., Grell, G., Webley, P., Peckham, S., and McKeen, S. A.: Inclusion of Ash and SO2 emissions from volcanic eruptions in WRF-Chem: development and some applications, Geosci. Model Dev. Discuss., 5, 2571-2597, doi:10.5194/gmdd-5-2571-2012, 2012.