



Small-scale volcanic aerosols variability, processes and direct radiative impact at Mount Etna during the EPL-RADIO/REFLECT campaigns

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Introduction

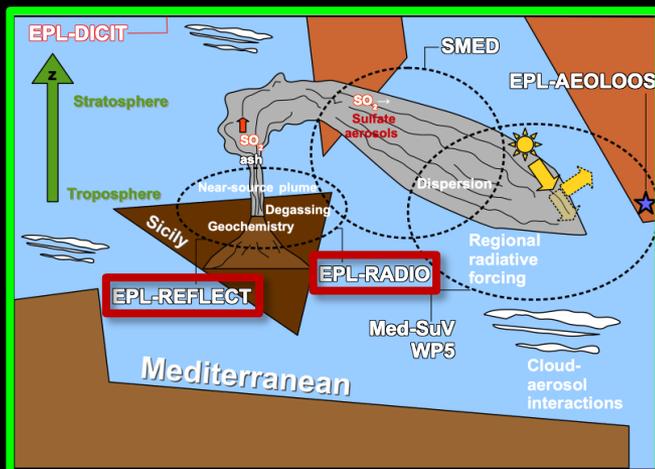
The EPL-RADIO/REFLECT campaigns

EPL-RADIO (2016-17): EtnaPlumeLab-Radioactive Aerosols and other source parameters for better atmospheric Dispersion and Impact estimatiOns

EPL-REFLECT (2019): near source estimations of Radiative Effects of voLcanic aErosols for Climate and air quality sTudies

Scopes (among others):

- 🔬 Improving the characterisation of Mt. Etna as a source of atmospheric aerosols
- 🌋 Linking inner degassing mechanisms to aerosol near-source characterisation
- ☀️ Estimating the impact of Mt. Etna aerosol emissions on AQ and climate

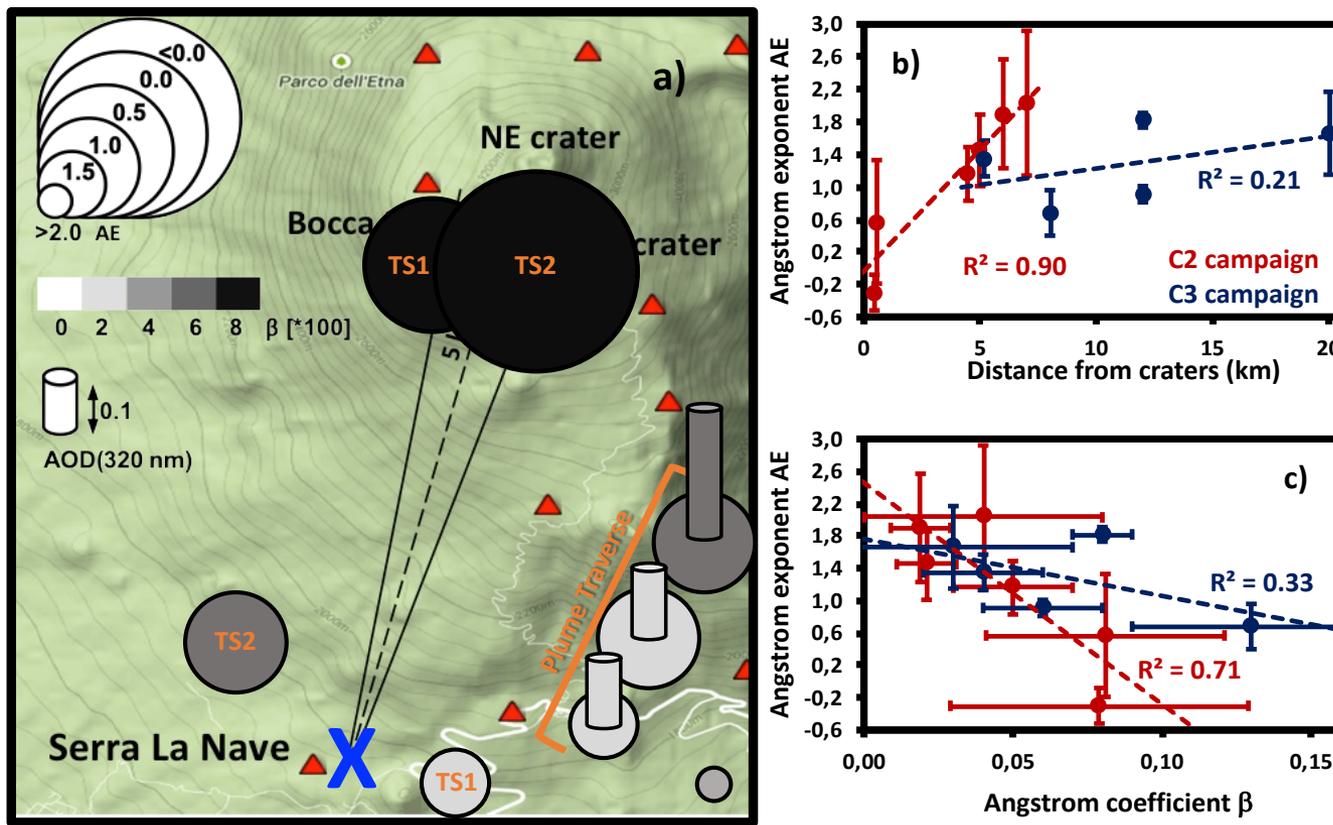


The EPL research cluster

Part of a larger multi-disciplinary, multi-scale and modular research cluster for the systematic characterisation of Mt. Etna's emissions and their impacts in the Mediterranean: **EPL (EtnaPlumeLab)**

Results

Variability of aerosol optical/micro-physical properties



First 3d short-term map of volcanic aerosols properties (AE: ~mean size; β : ~burden/composition) with portable photometry

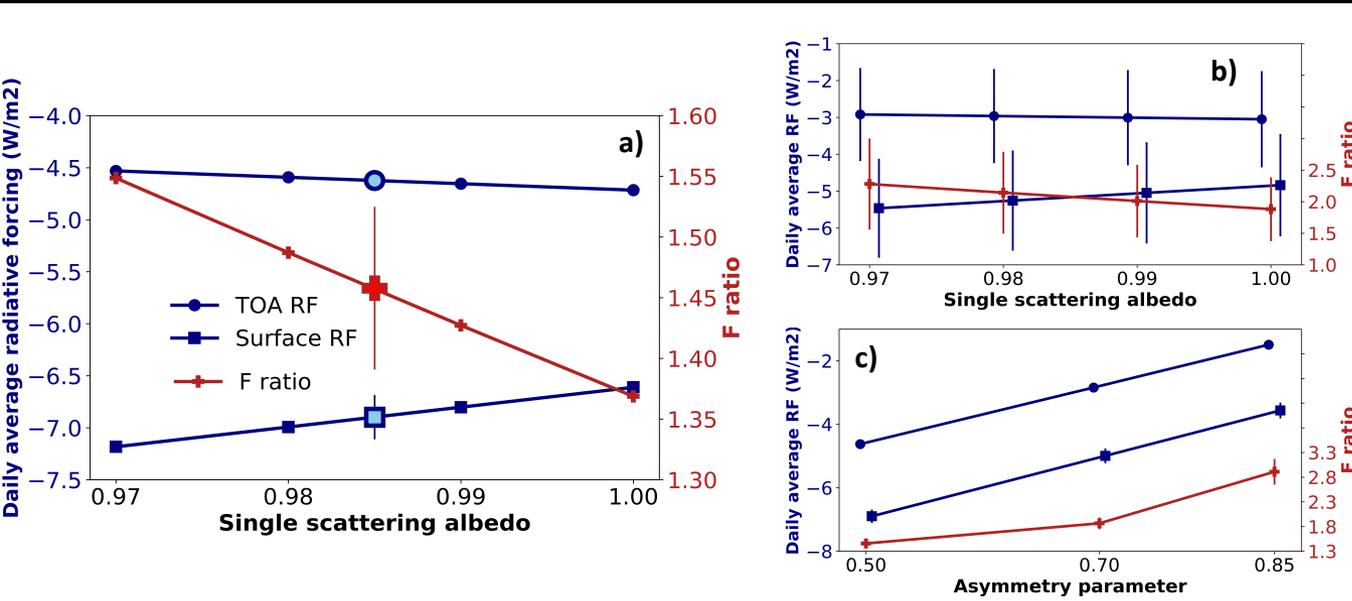
New method combining UV/VIS/NIR information with MicroTops [Sellitto et al., 2017]

Very strong variability of aerosol properties at small spatial scales (model sub-grid/satellite sub-pixel)

Bigger particles and bigger burden at proximal locations, better correlation of these quantities during passive activity (no ash) → important role of ash sedimentation/secondary SA formation processes

Results

Local/regional radiative forcing of passive degassing plume



First estimation of the shortwave (solar) RF of passive degassing plumes (radiative modelling; input: vertically-resolved aerosol extinction from LiDAR, validated with simultaneous photometric observations)

Local/regional (equinox-equivalent daily) RF up to -4.5 w/m²: locally offsets the effect of global warming

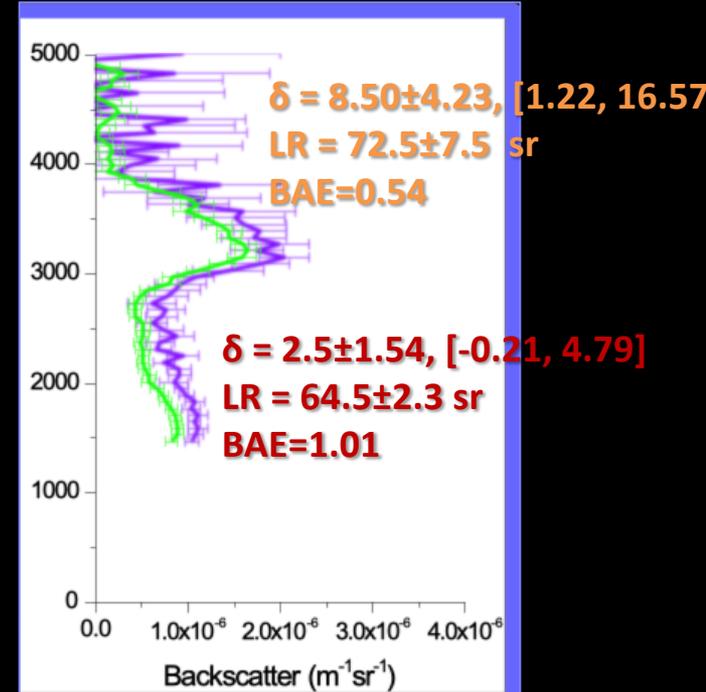
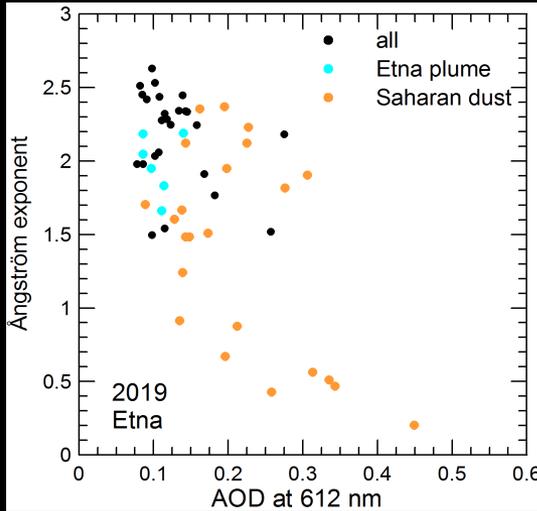
Local impact of (very frequent) passive degassing similar magnitude as regional impact of advected SA-dominated plumes from (infrequent) explosive eruptions

In case of small amounts of ash (more absorbing → smaller SSA; coarser → larger asymmetry parameter), unbalances of TOA/surface RF can produce local radiative heating in the atmosphere

Results Co-presence of other aerosol types

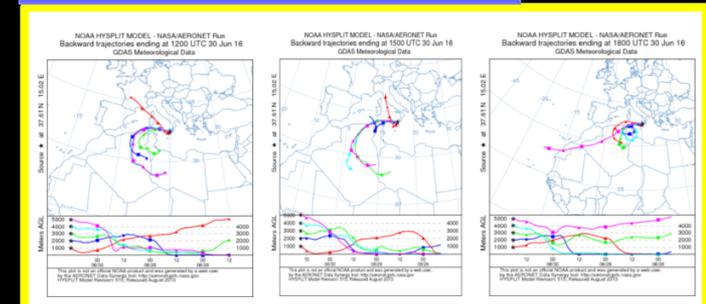
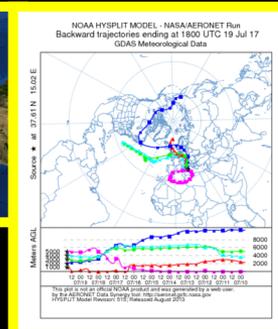
**Volcanic (Etna) +
Dust (Sahara):
30/06/2016**

**Frequent co-presence
of volcanic aerosols from
Etna and Saharan dust
(using ground-based
radiometry and dispersion
models, in some cases double
layers precisely observed
with LiDAR)**



**Mount Etna area is crossroad of different aerosol types (most notably Saharan dust) which can mix with volcanic aerosols
Strong RF due to dust is expected (estimations ongoing)**

**Other aerosols
types
are detected,
for example
biomass burning from South Italy fires**



Conclusions + What's next?

Mt. Etna emits aerosols and/or aerosols precursors of relevance for regional climate and AQ

The EPL-RADIO/REFLECT campaigns targeted these emissions and inherent small-scale processes and impacts

Multi-scale studies, involving multi-disciplinary community (🌋 + ☁️) necessary to quantify the activity-dependent regional impacts

More studies to come (a few examples):

- Aerosol toxicity (see next presentation, Chiara Giorio)
- Impact on the photochemistry
- Long-term RF observations

Thank you for your attention!

