Recovered measurements of the 1960s stratospheric aerosol layer for new constraints for the volcanic forcing in the years after 1963 Agung

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The 1960s was highly volcanically active after 4 quiescent decades.

- Major volcanic eruptions are dominant forcing signatures within historical climate change.
- The 1963 Agung eruption (Bali) occurred after 40 years (1920-1960) with very little volcanic activity.
- 1960s strongly volcanic decade with tropical strat-injecting eruptions in -- September 1965 (Taal, Philippines) -- August 1966 (Awu, Indonesia) -- June 1968 (Fernandina, Ecuador)
- First in-situ measurements of the stratospheric aerosol layer from balloon (Junge et al., 1961) and the U-2 aircraft (Junge and Manson, 1961)
Stronger and earlier Agung cooling in CMIP6 than in CMIP5

- In CMIP5, most climate models used the Sato et al. (1993) volcanic aerosol dataset, which enacted Agung cooling based on surface radiation measurements (Dyer & Hicks, 1968)
- CMIP6 volcanic aerosol dataset based on ETH 2D-AER interactive strat-aerosol integrations
“1960s hiatus” in 15-year global surface temperature trends


Initial analysis of CMIP6 15-year GMST trends shows problem has got worse for 1950s start years → Agung cooling too strong?
1960s data recovery within WCRP stratospheric sulphur activity “SSiRC”

• Current 2nd phase of Stratospheric Sulphur and its Role in Climate (SSiRC) has begun a data rescue of stratospheric aerosol measurements focused on periods after major eruptions. (see http://www.sparc-ssirc.org/data/datarescueactivity.html).

• Initial focus on gap period after 1991 Pinatubo and 1960s in-situ and active remote sensing obs
  -- **Pinatubo** -- **ship-borne lidar** measurements of tropical Pinatubo plume **July-Sep 1991** from transect of North Atlantic on Russian vessels (Avdyushin et al., 1993)
  -- **ground-based lidar** from Melbourne, Australia **Jul91 to Mar92** (Young et al., 1994)
  -- **airborne lidar** from NASA Electra flights in July 1991 (Winker and Osborne, 1992)
  -- **post-Agung** -- 10 dust-sonde flights from Minneapolis in 1963-66 (Rosen, 1964; Rosen, 1968)
    -- **ground-based lidar**, Lexington, 66 profiles: Jan64- Jul65 (Grams & Fiocco, 1967)
    -- **aircraft impactor samples** from U-2 global surveys (Mossop, 1964; Friend, 1966)
    -- **ground-based searchlight**, New Mexico, 99 profiles Dec63-Dec64 (Elterman, 1966)

• Pinatubo ship-borne lidar submitted for doi on PANGAEA archive (https://www.pangaea.de), a paper with data and recovery methodology in review on ESSD (Antuna Marrero et al., 2020)
1960s measurements: potential to improve Agung forcing and link with ISA-MIP activity for interactive stratospheric aerosol models

• Already compared CMIP6 dataset and UM-UKCA simulations to Lexington lidar.
• Currently discussing with Jim Rosen re: uncertainty for Minneapolis size cuts, initial calibration, e.g. Aug 1963 for N(r>300nm) and later re-calibration (Pinnick et al., 1973)
• Terry Deshler will also contribute re: size re-calibration and comparisons to model

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