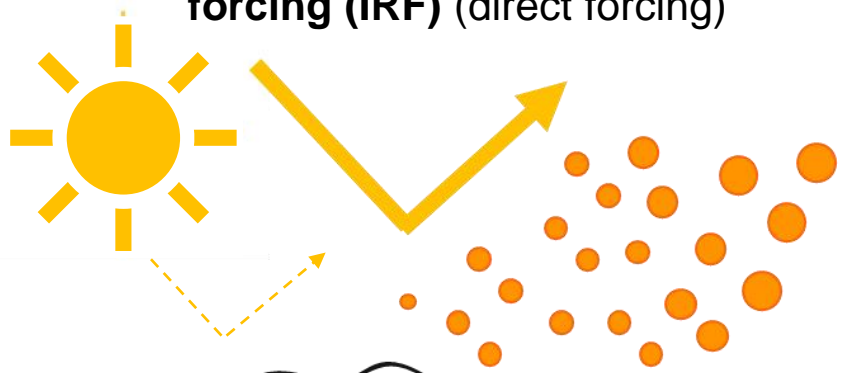


How does Volcanic Stratospheric Aerosol Optical Depth Translate into Volcanic Radiative Forcing?

Conversion needed for IPCC calculations, energy balance models and for understanding volcanic aerosol forcing efficiency

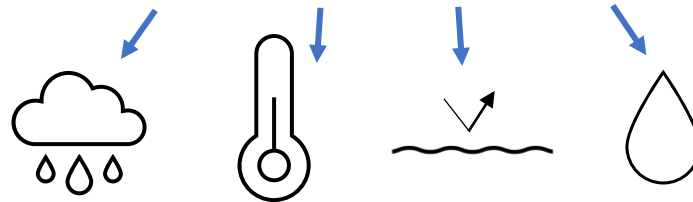
1. Instantaneous Radiative forcing (IRF) (direct forcing)



Tropical and extratropical **winter** eruptions have **stronger** forcing


2. Rapid adjustments (RA)

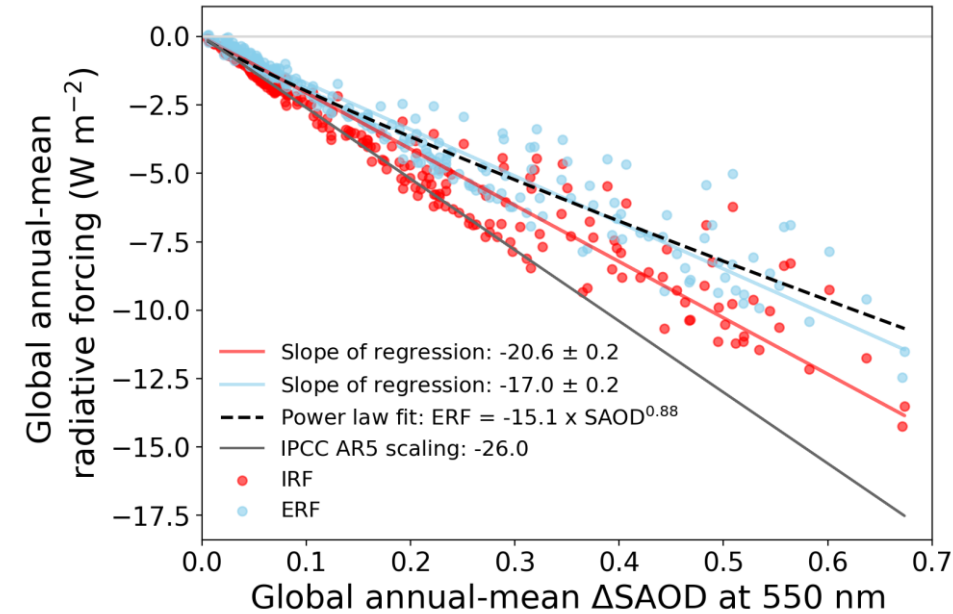
Eruptions induce changes to clouds, temperature, albedo, and water vapour that change the radiative forcing



3. IRF + RA = Effective Radiative forcing (ERF)

Total rapid adjustments in our simulations are positive and **reduce the net negative forcing by 21%**:

- Driven mainly by a **SW cloud** adjustment 
- Larger for January eruptions (regardless of latitude) due to a larger tropospheric temperature adjustment



4. What is the relationship between SAOD and ERF?

From 82 **aerosol-microphysical** simulations of a wide range of eruptions (SO₂: 10-100 Tg, latitude: 80°S-80°N, season: Jan and Jul):

- ERF = **-17.0** × SAOD (linear regression) (**IPCC AR5 = -26.0** × SAOD)
- ERF = **-15.1** × SAOD^{0.88} (power law)