Volcanic Eruptions and Cirrus Clouds

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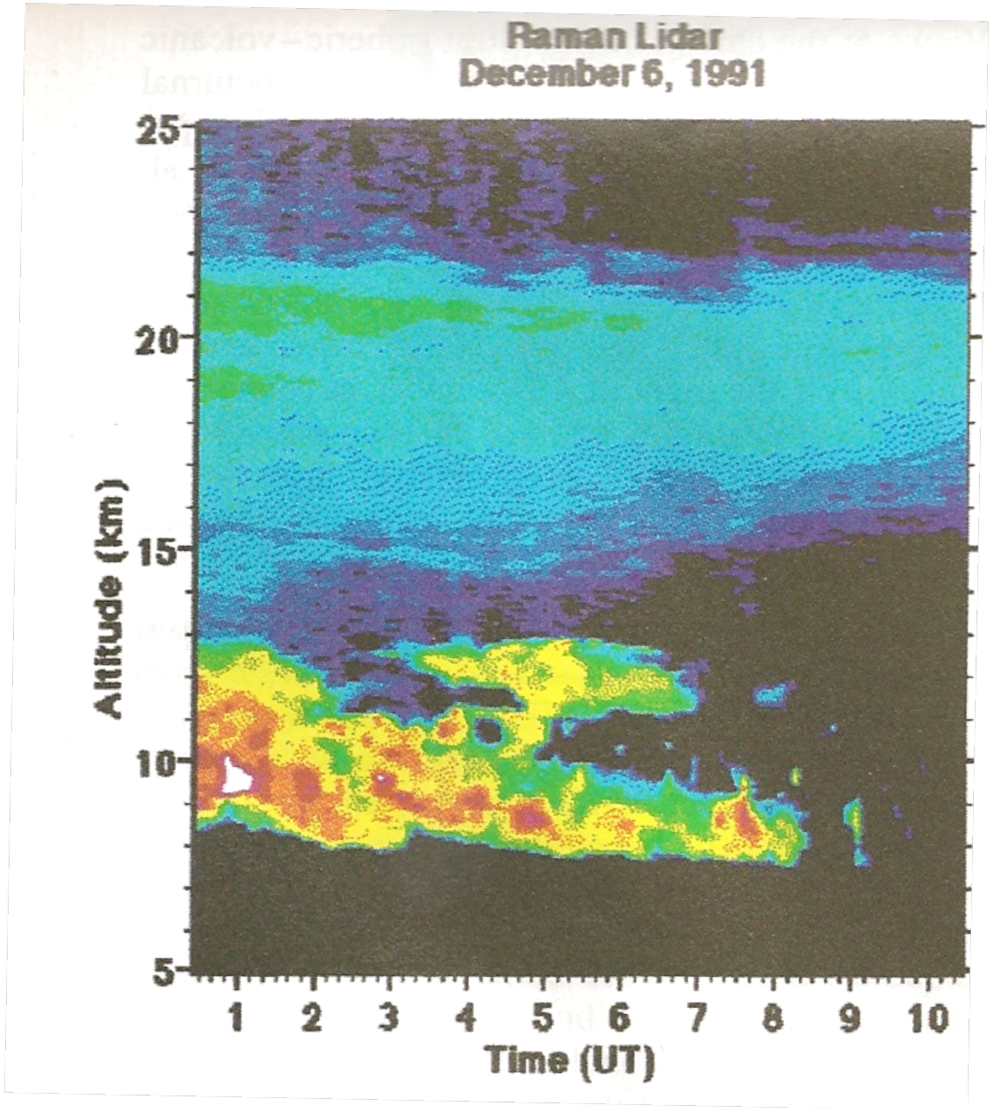
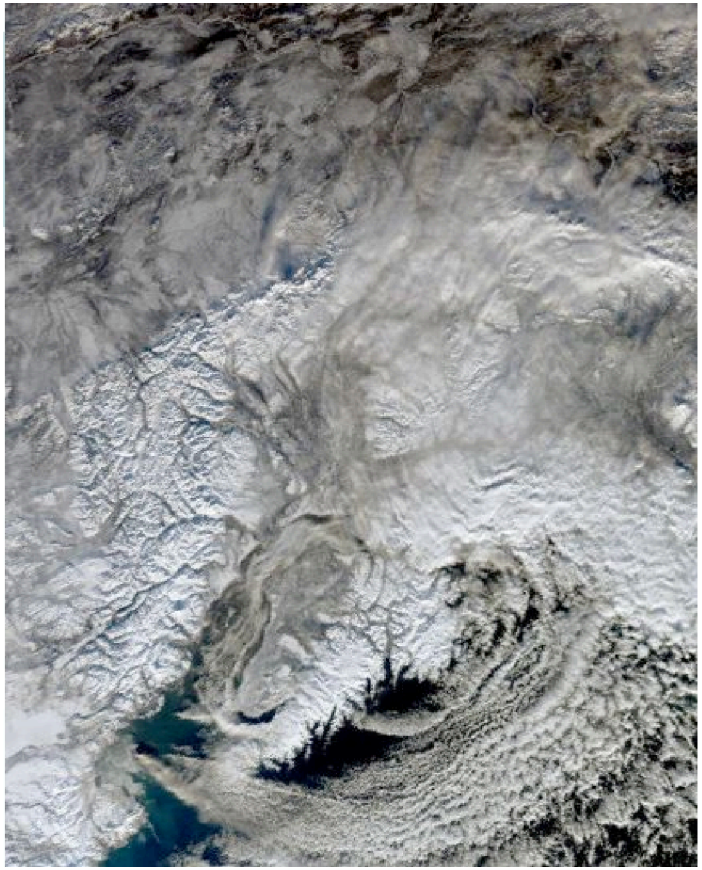
Post-Pinatubo: FIRE IFO II

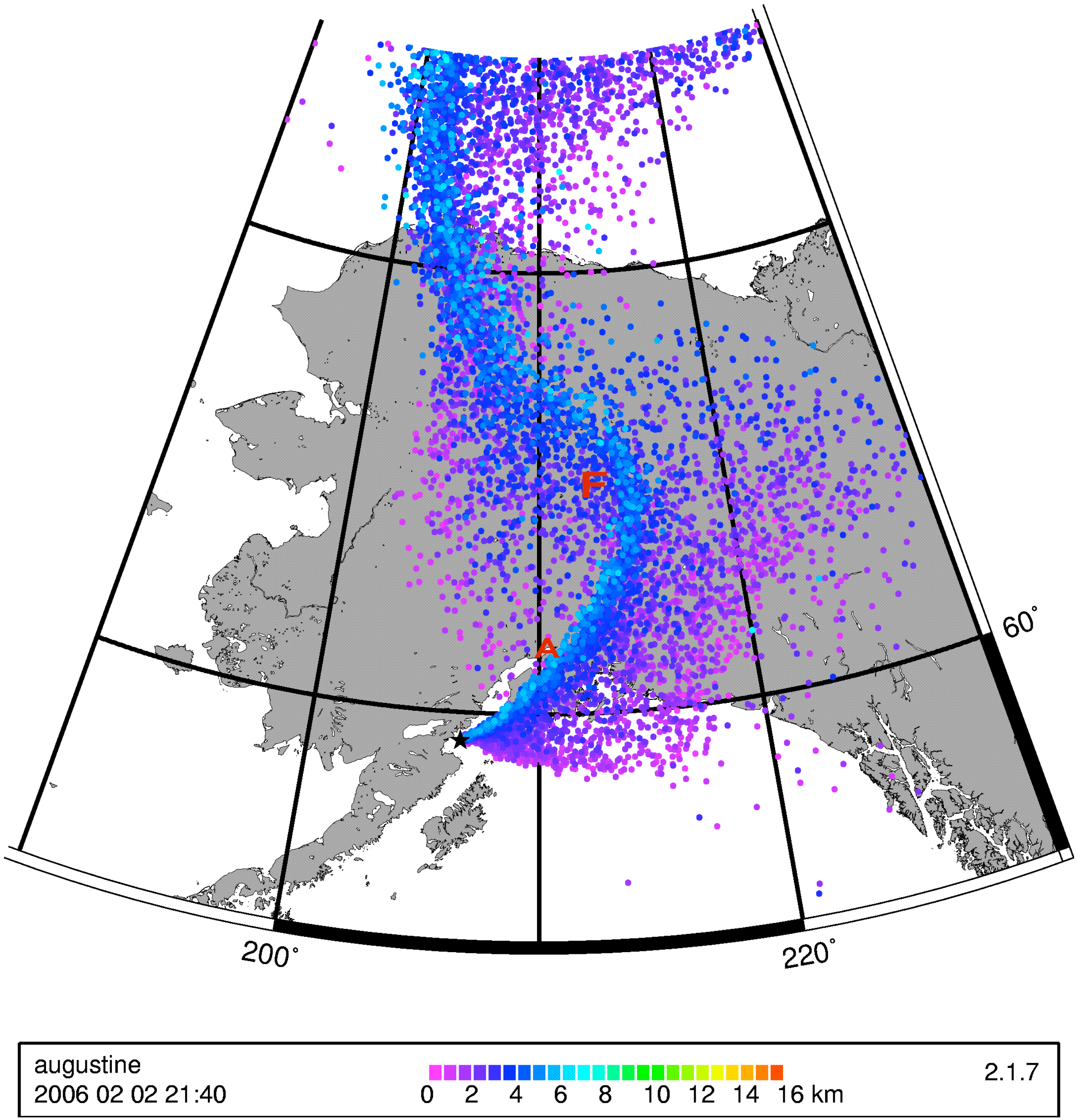


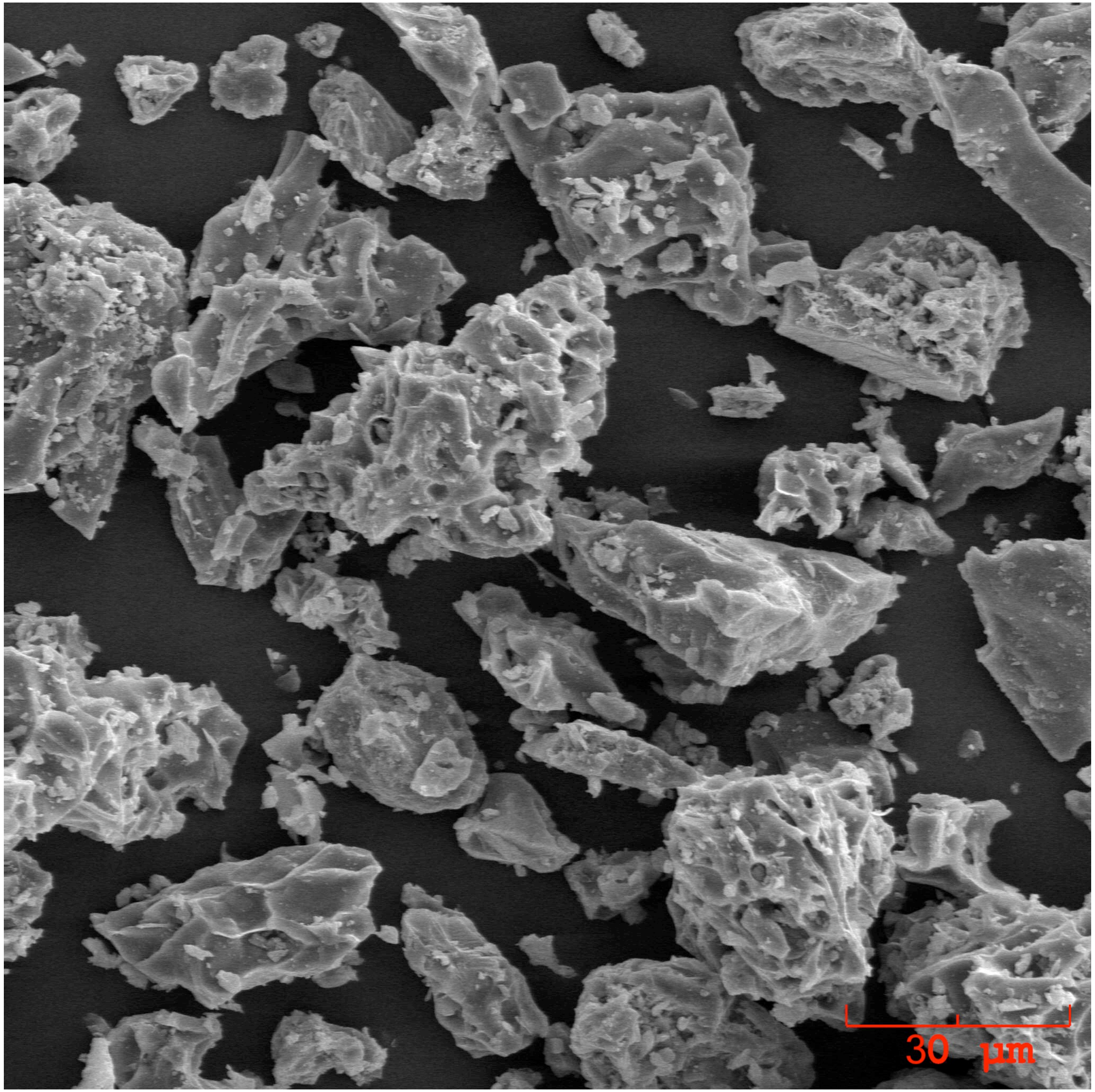
Augustine Volcano Eruption, AK



MODIS
2200 UTC
2/2/06

UAF PUFF Model




30 µm

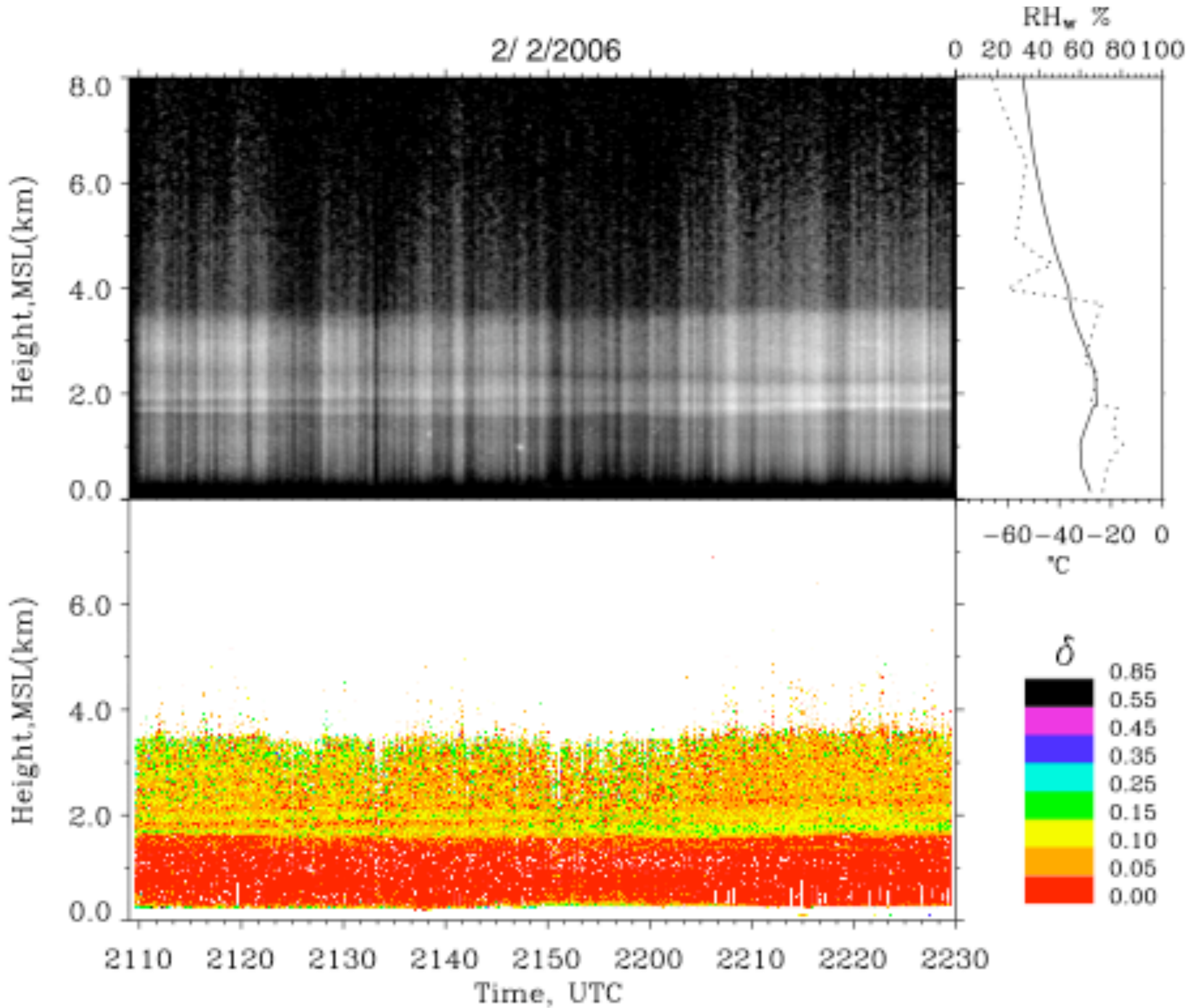
AFARS Remote Sensors

Cloud Polarization
Lidar (CPL)
0.694 μm
0.1 Hz PRF

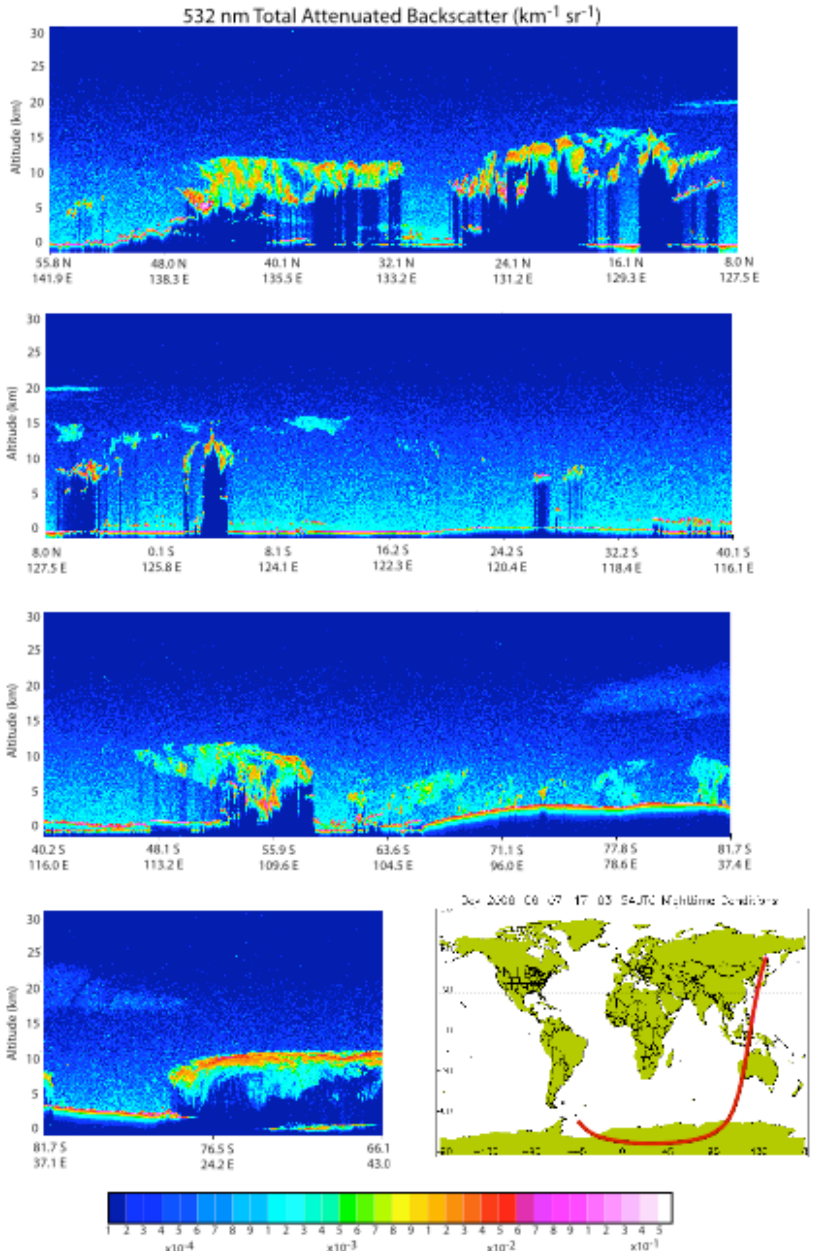
• Polarization
Diversity Lidar (PDL)
Scanning,
0.532 + 1.06 μm,
10 Hz PRF

• W-band Doppler
Radar
3.2 mm
Polarimetric

AFARS Polarization Lidar



CALIPSO 'First-Light' Lidar Measurements
7 June 2006



Ice Nucleation by Ejecta

(after fallout into the upper troposphere)

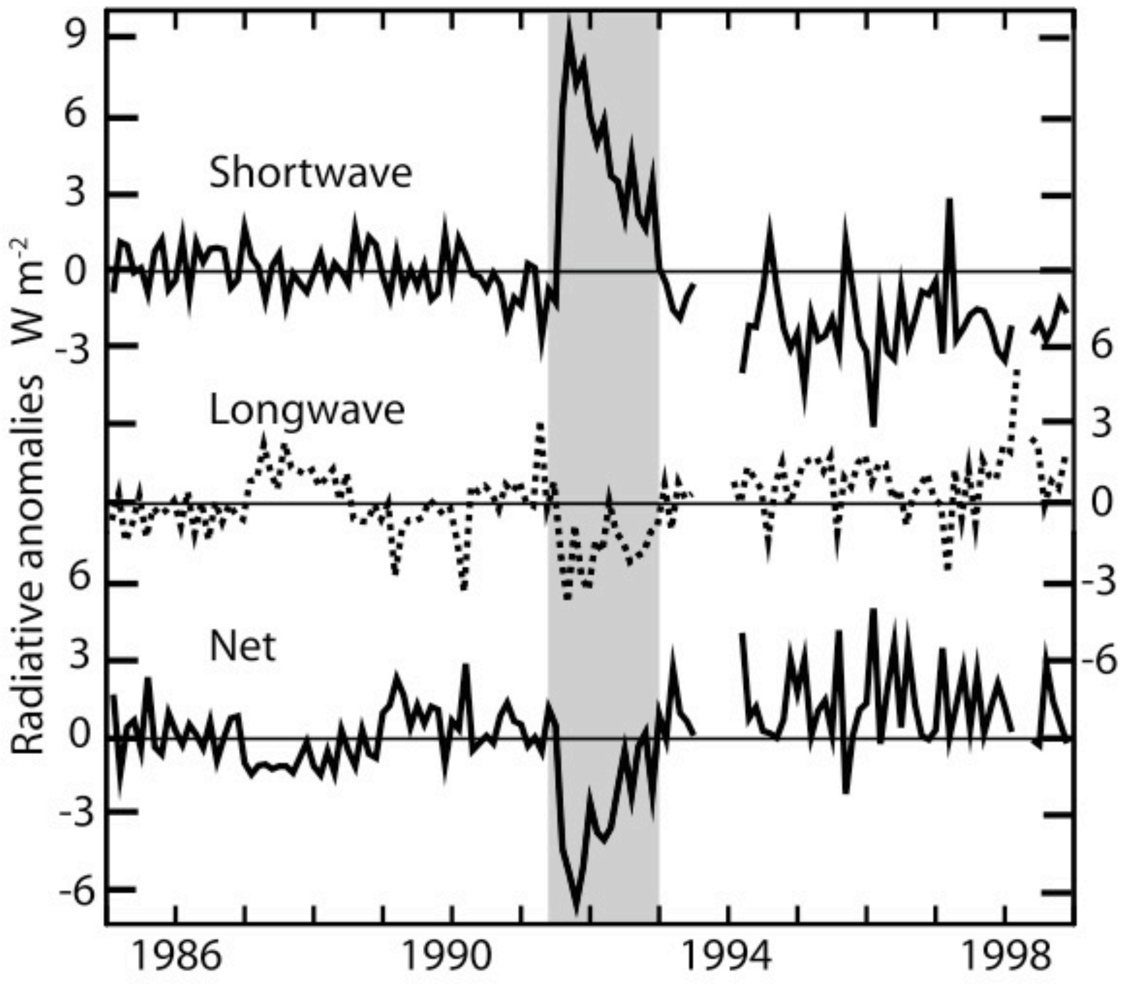
- Volcanic dust is an excellent IN (Isono et al. 1959; Durant et al. 2008; Bingemer et al. 2011)
- Diluted sulfuric acid droplets produce ice via homogenous nucleation (Sassen et al. 1995)
- Neutralized acid drops become sulfate crystals, haze drops, and ice crystals homogeneously (Sassen et al. 1989)

Speculated Cloud Effects

- Altered ice crystal shapes and sizes (Sassen et al. 1995)
- Enlarged sulfuric acid drops (Sassen 1992)
- Increased cirrus clouds (Minnis et al. 1993)
- Hydrological cycle changes? (Trenberth 2007)

Pinatubo Radiative Effects- ERBS

(Trenberth and Dai 2007)



Volcanic Cirrus Climate Implications

- Global Cooling: More high thin cirrus with high concentrations of small (*r* <~2.5 μm) crystals (Räisänen et al. 2006, *Atmos. Chem. Phys*.)
- Global Warming: More “normal” cirrus in otherwise cloud free air, or denser cirrus
- Uncertain: Radiative response to altered ice crystals shapes (as lidar depolarization shows), and to depositional ice nucleation?