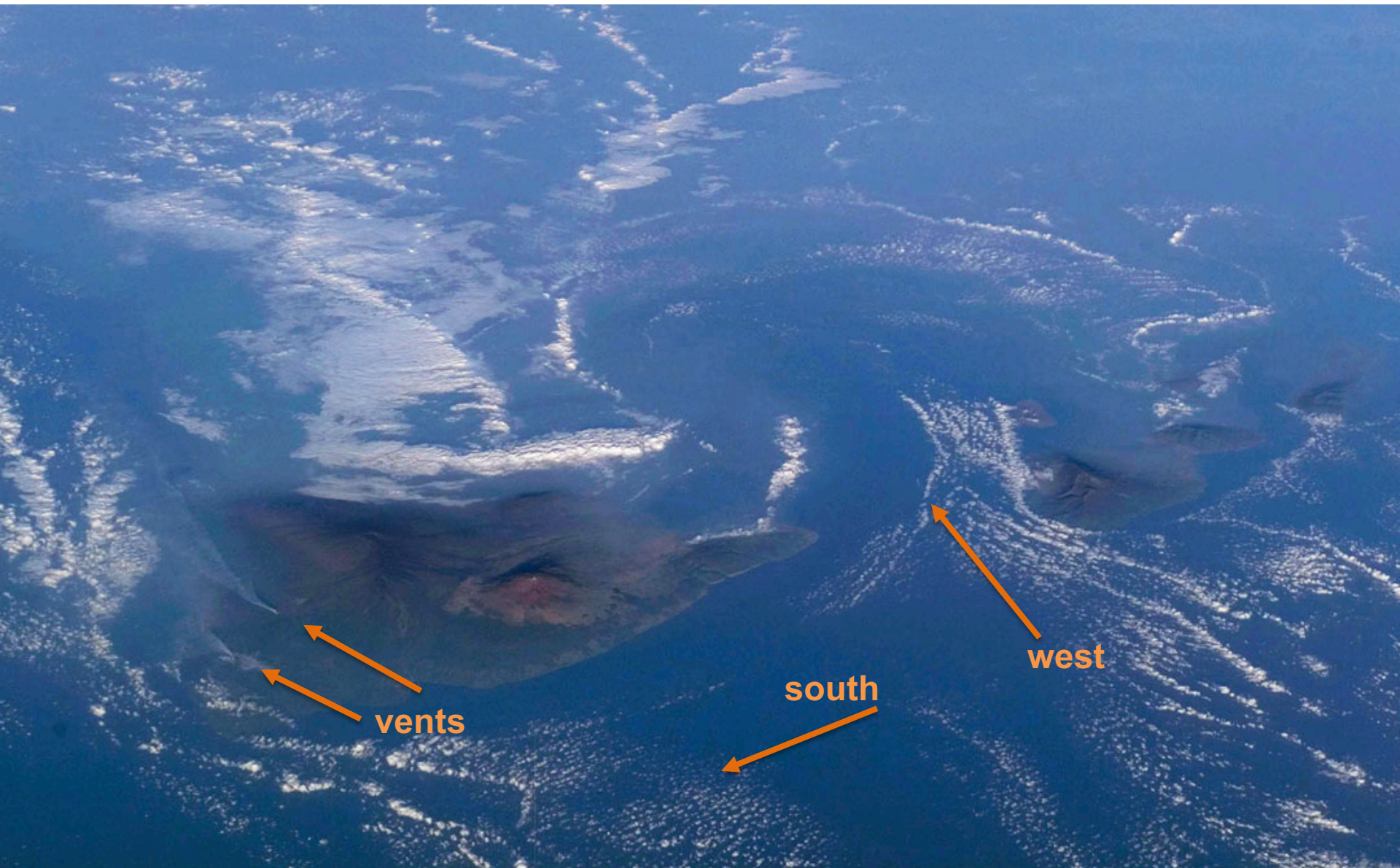




Effects of Hawaiian Volcanic Sulfate Aerosols on Clouds, Precipitation, and Energy Balance

Tianle Yuan, Donifan Barahona, Huisheng Bian, Mian Chin, Hongbin Yu, Lorraine Remer, Roger Shih, Hua Song, Qian Tan

The Hawaiian volcano



The Hawaiian volcano

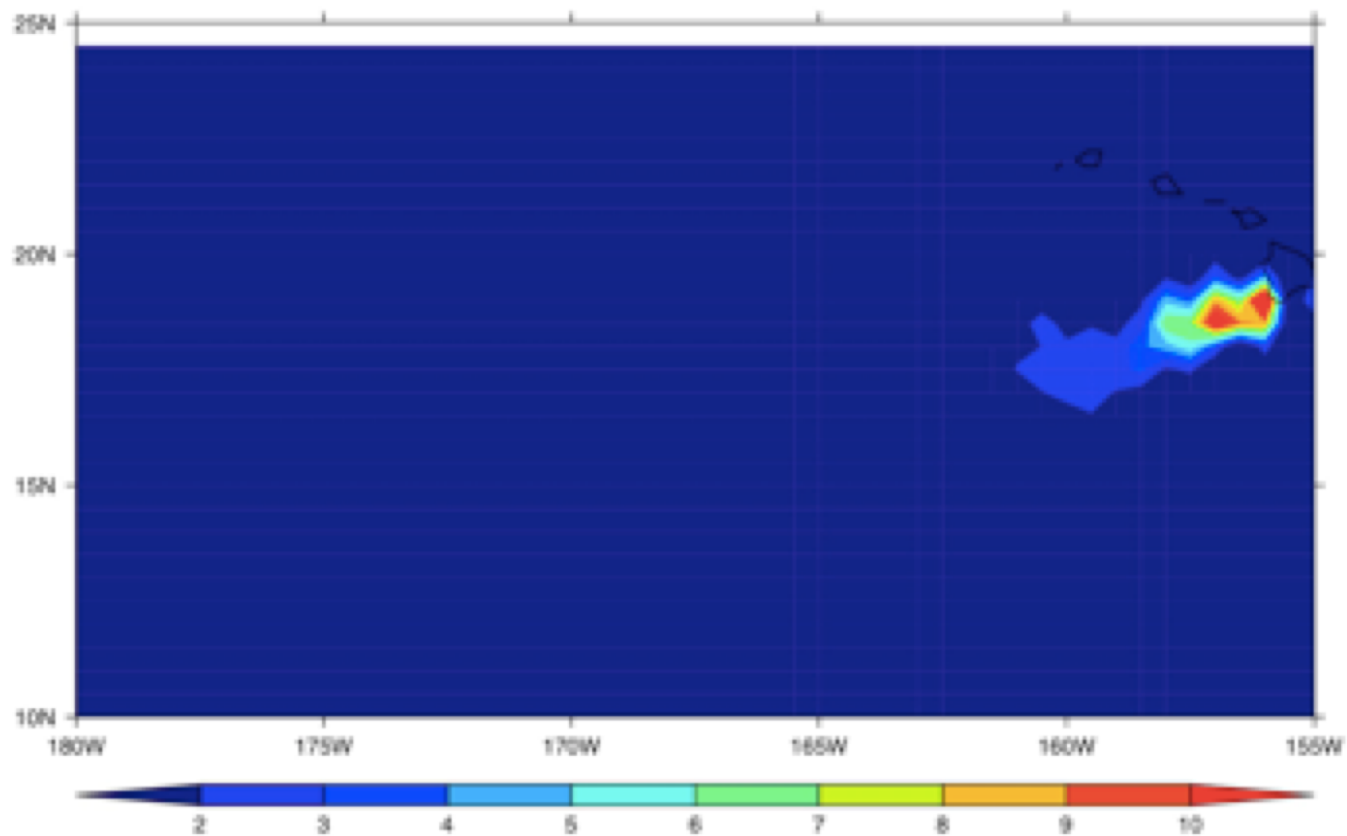


Lava meets ocean

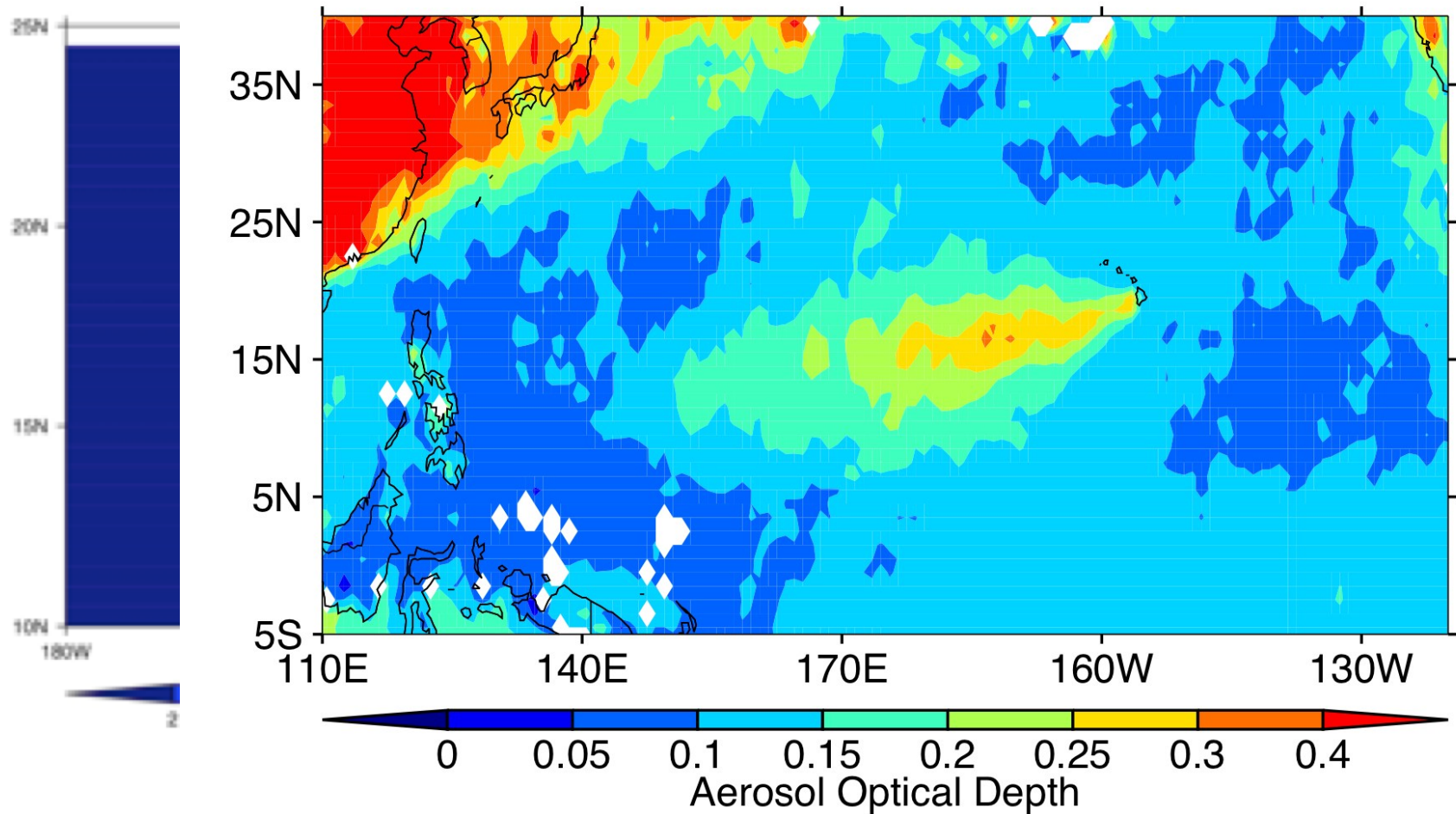
New 'land' from lava flow

Outline

- Recap observational analyses for the period 2002-2010
- Updated analysis for 2002-2017
- GCM modeling of the event
- Conclusion and outlook



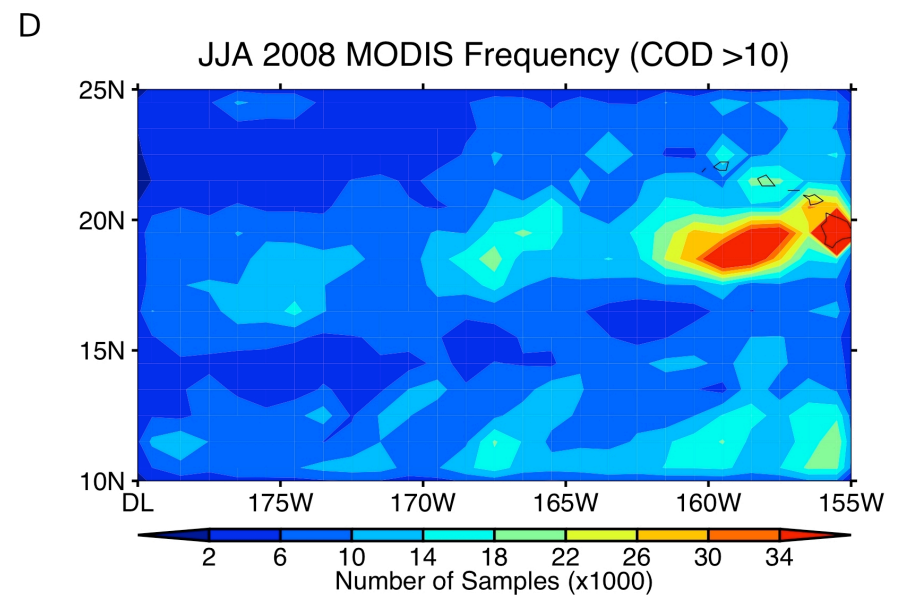
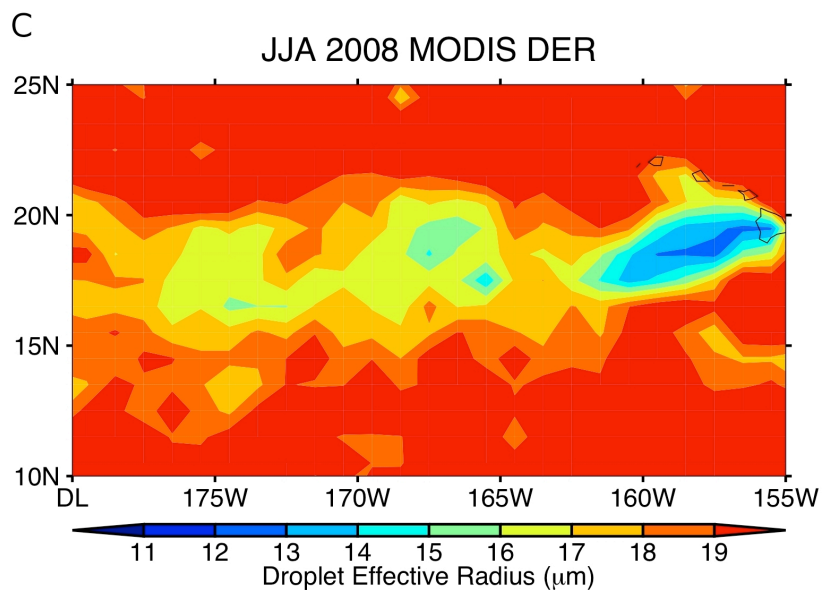
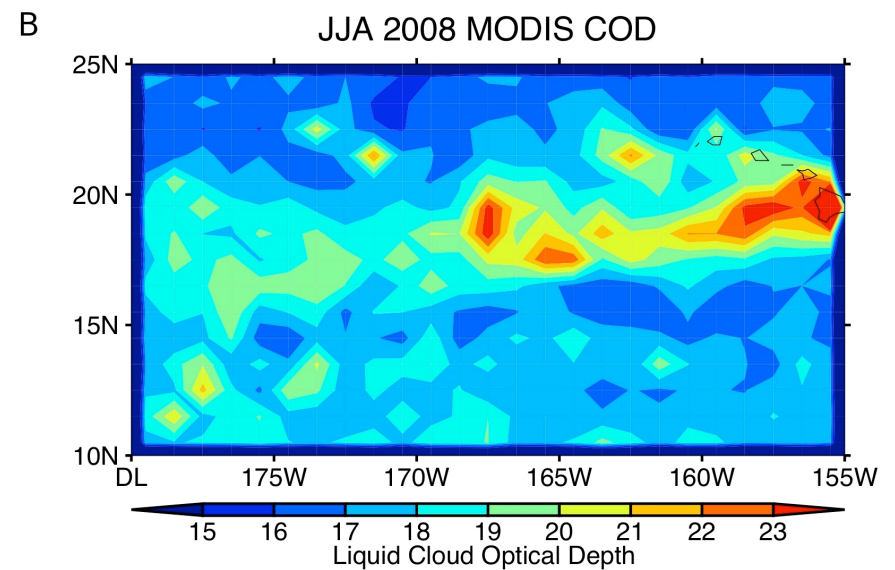
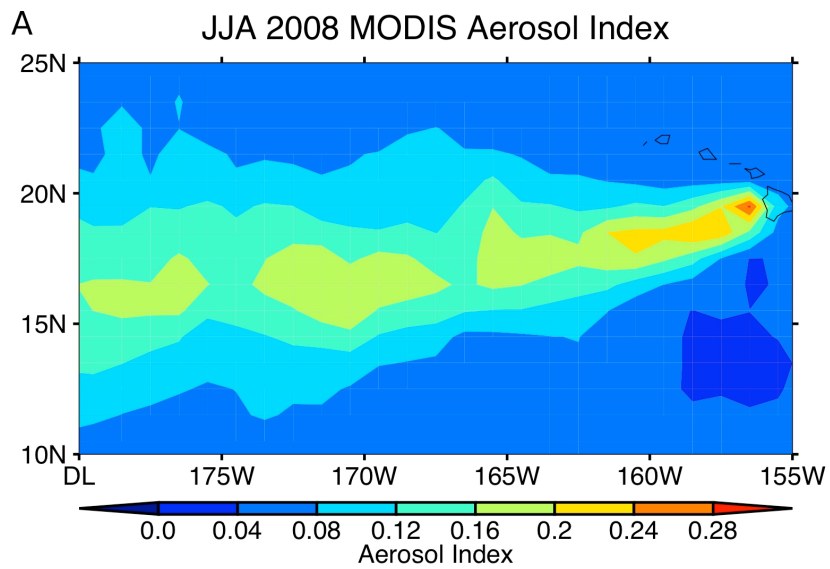
Yuan et al. (2011)



Yuan et al. (2011)

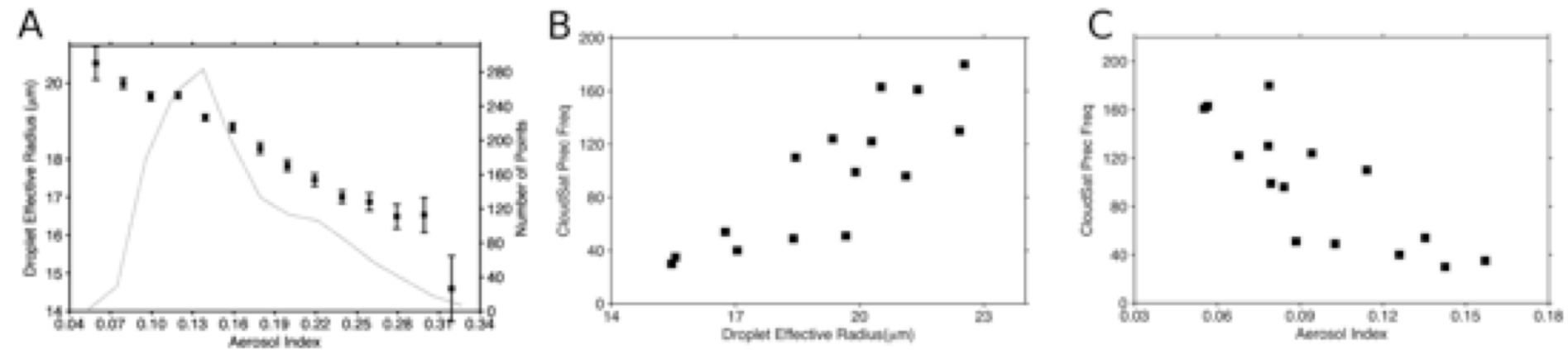
MODIS AOD

The Hawaiian volcano

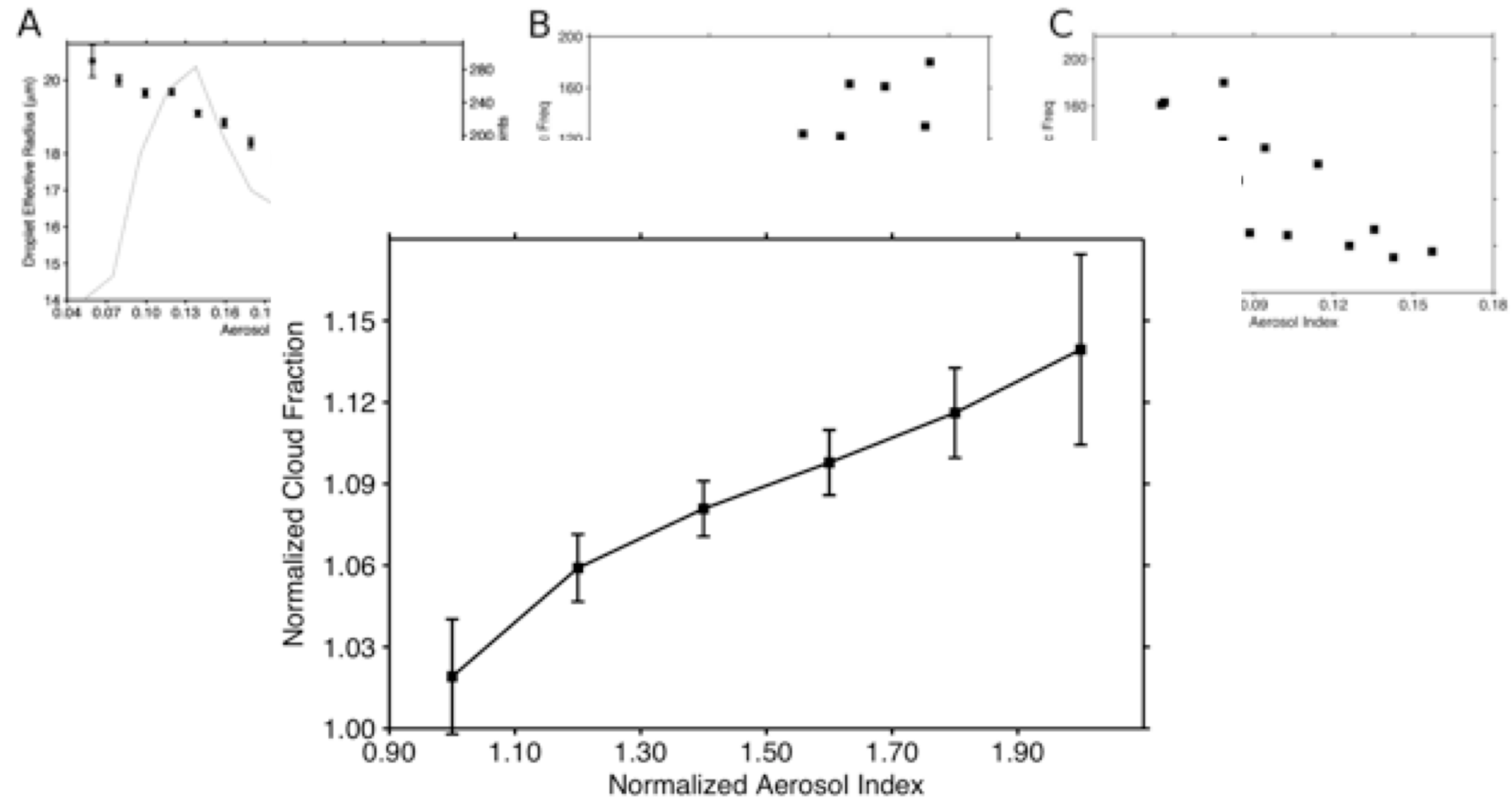


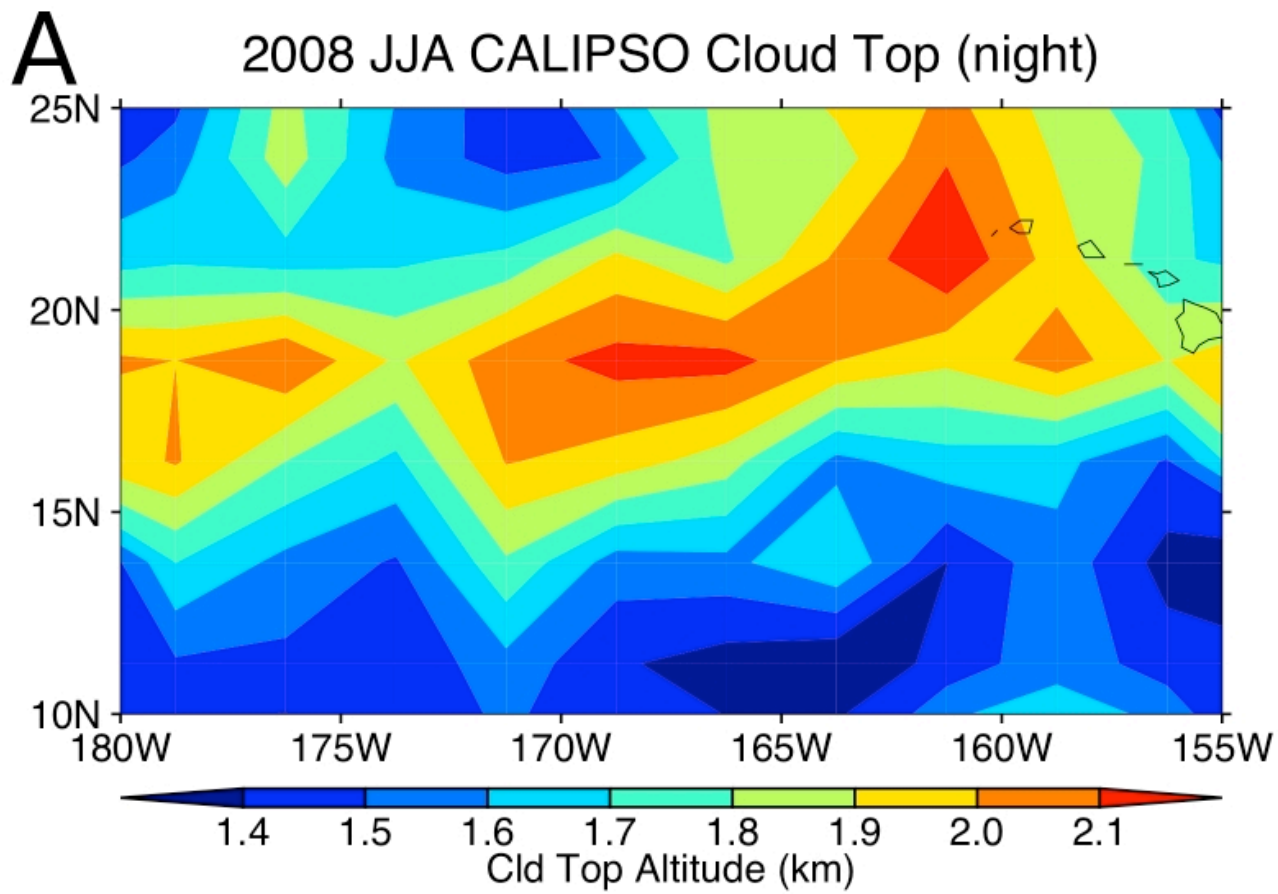
Volcano plumes

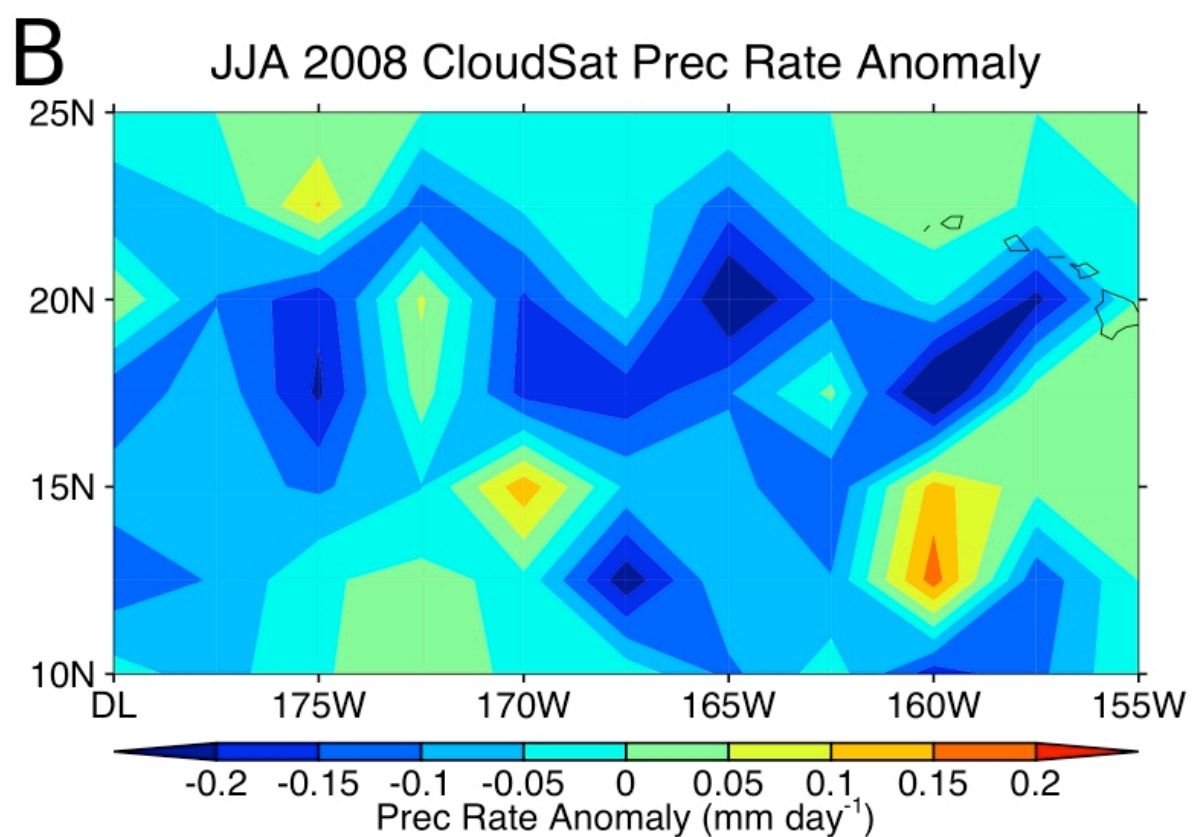
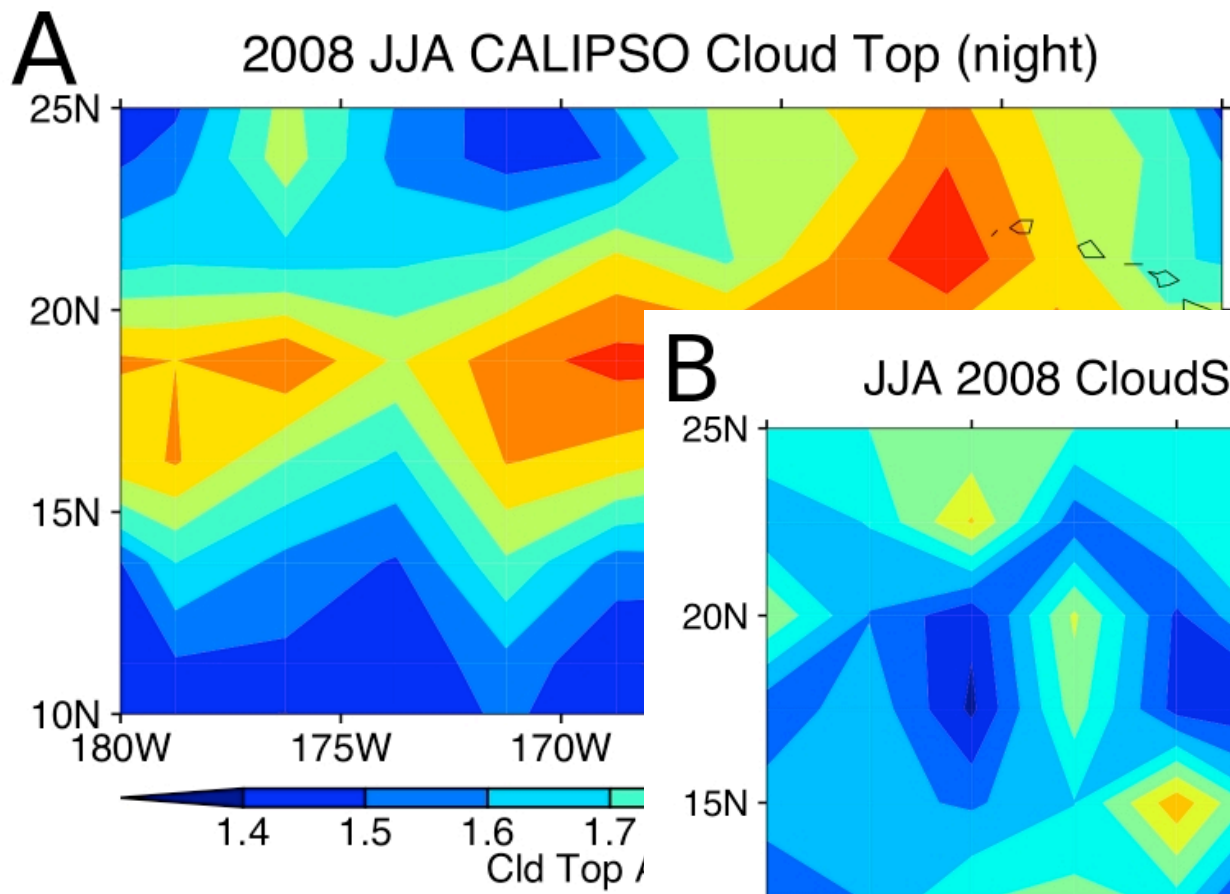
microphysical



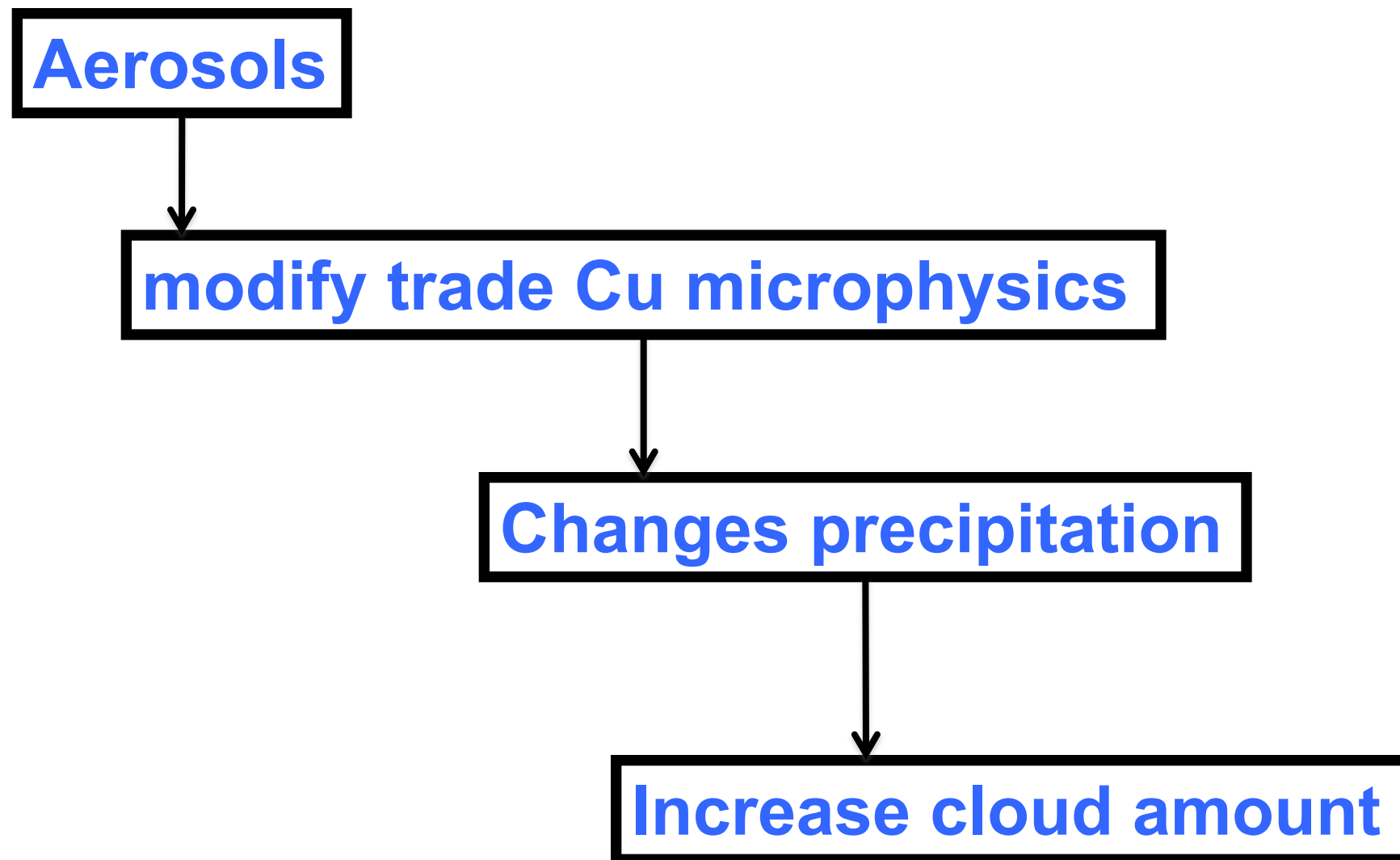
microphysical





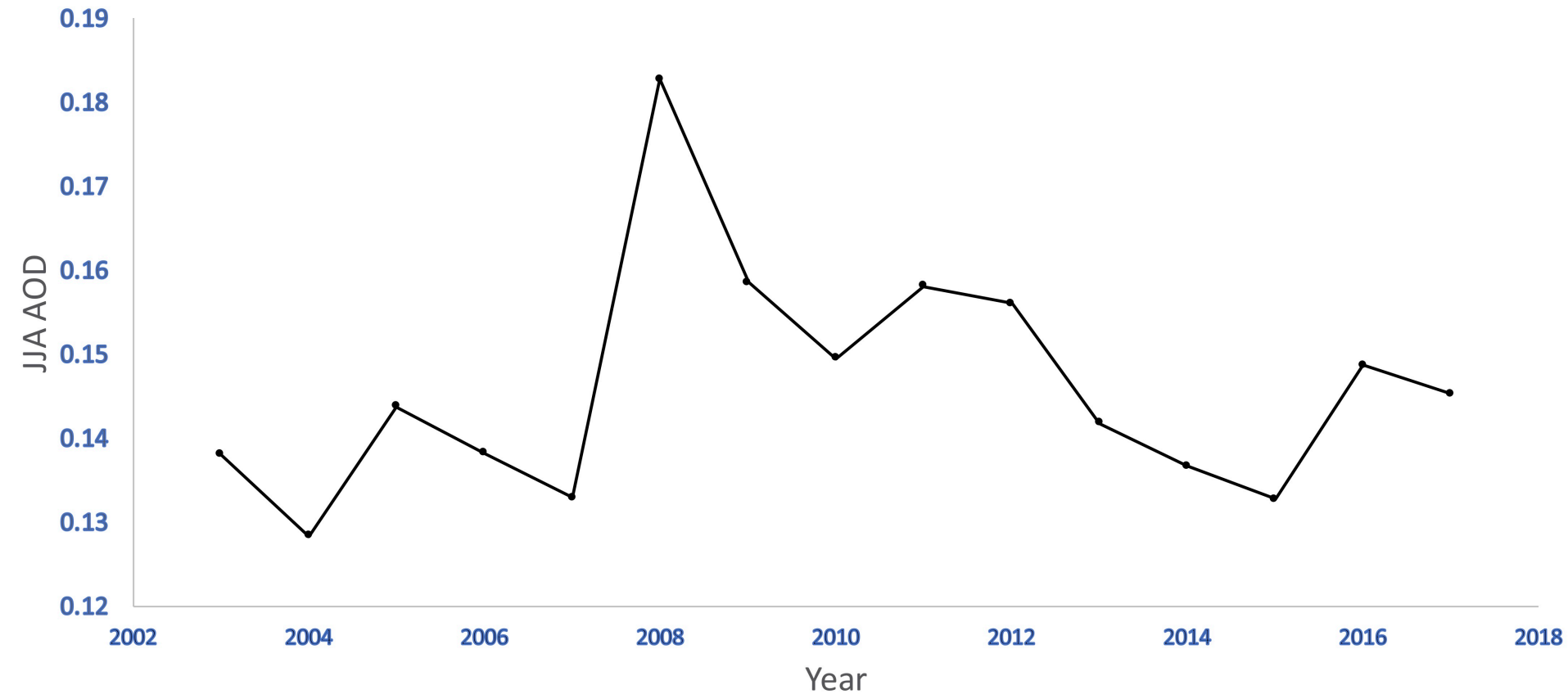


A recap of our previous investigation

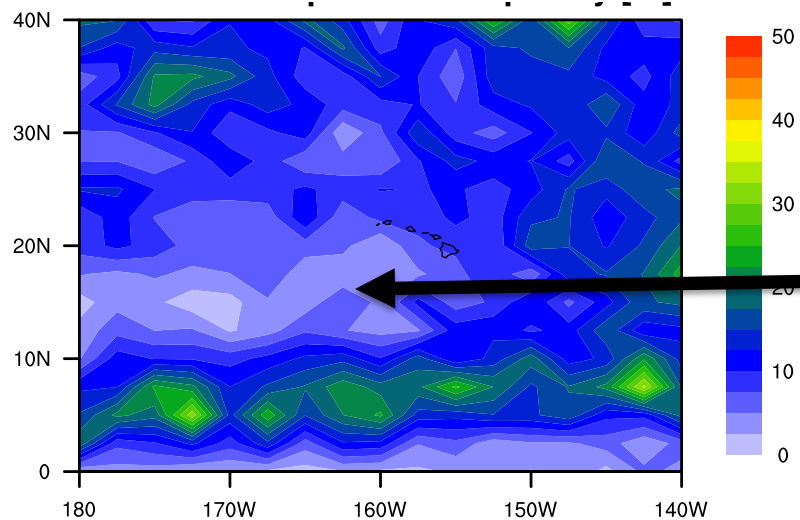


(Yuan et al., 2011, ACP)

Areal average downwind of Hawaii from Aqua

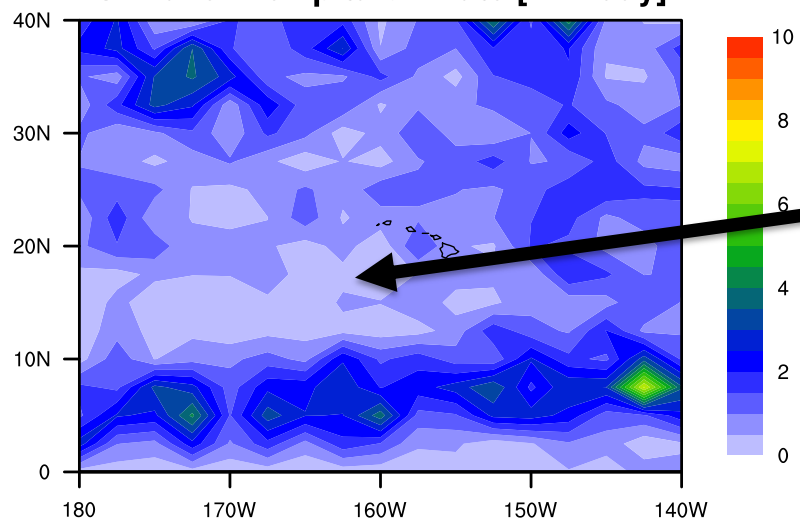


The Hawaiian volcano



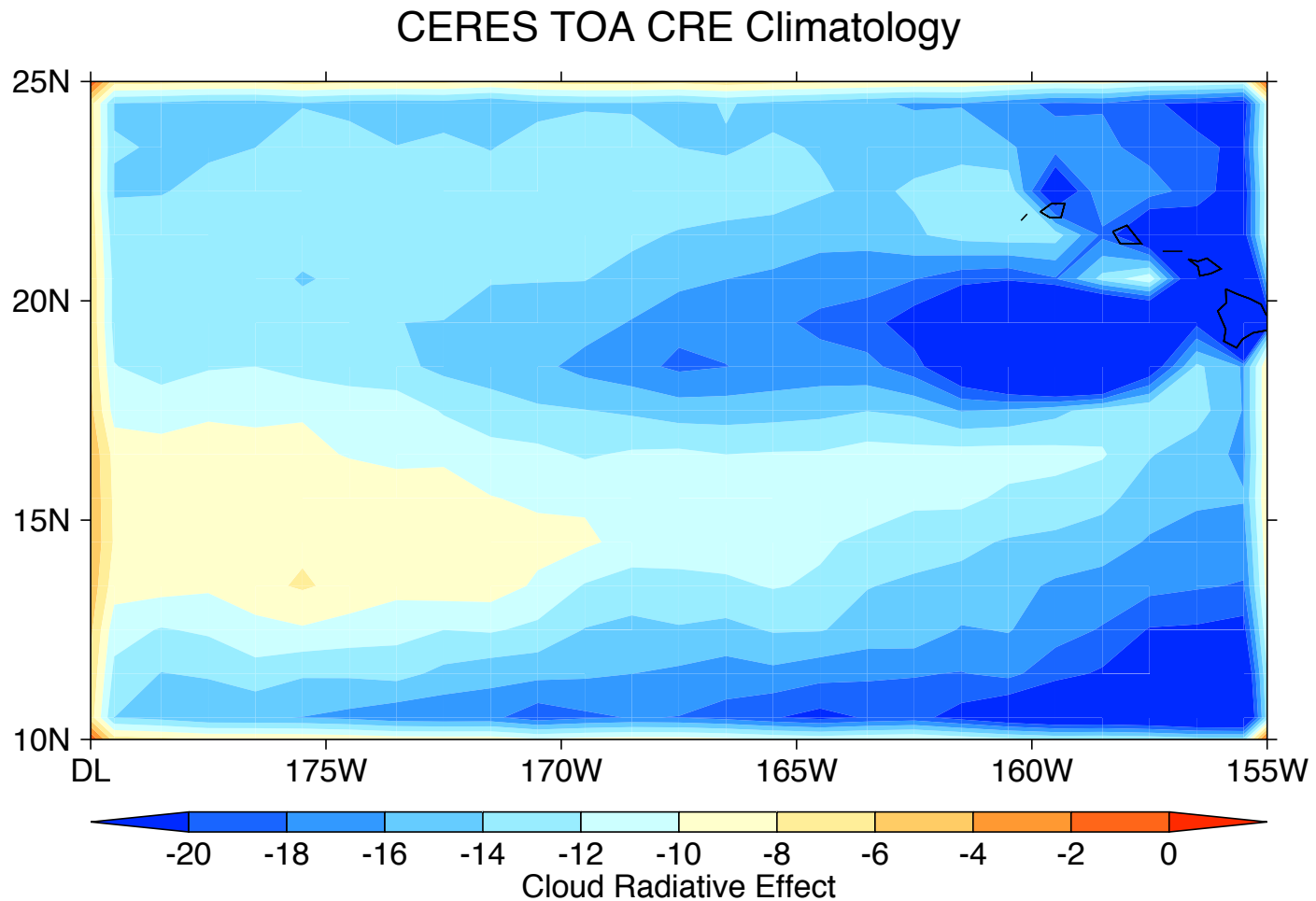
Precipitation likelihood
lowest in CloudSat record

Surface Precipitation Rate [mm/day]

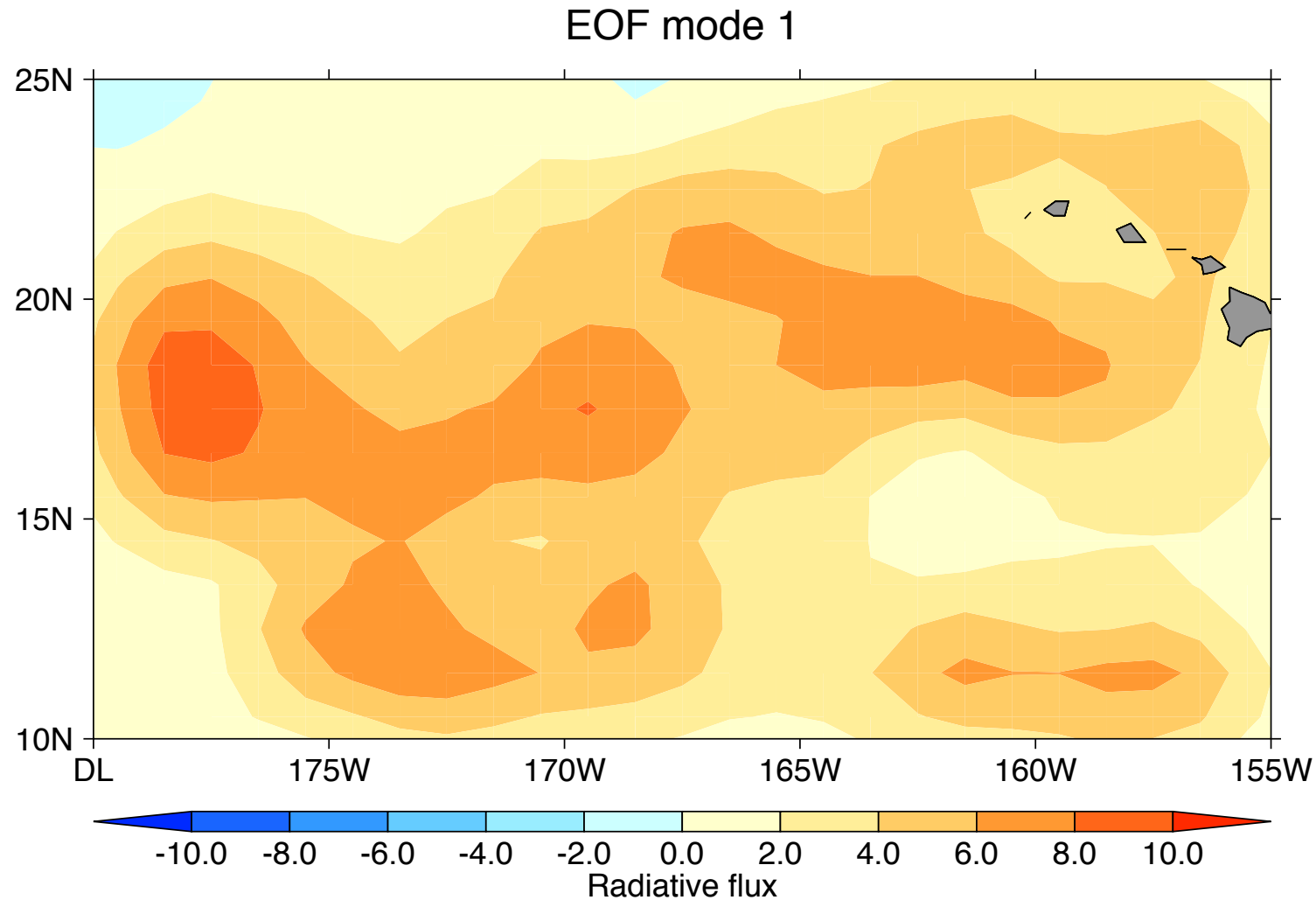


Precipitation rate is also
among the lowest

CloudSat-2C-PRECIP-COLUMN_2.5x2.5_Precip_freq_rate_JJA_2008.TP



CERES Cloud Radiative Effect JJA Climatology



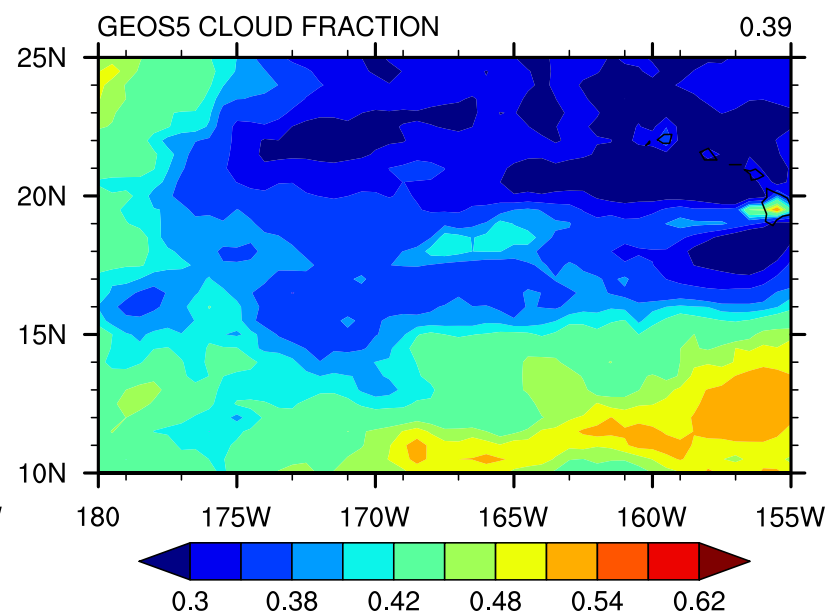
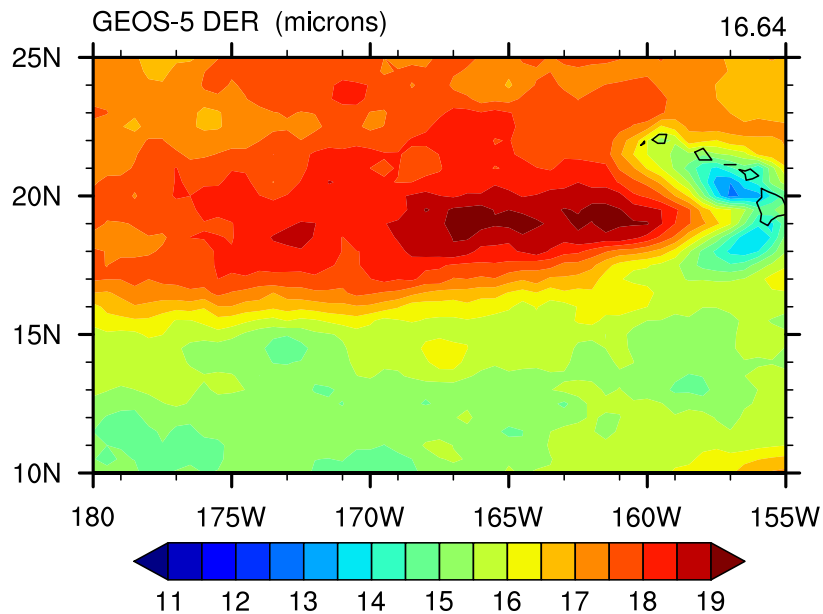
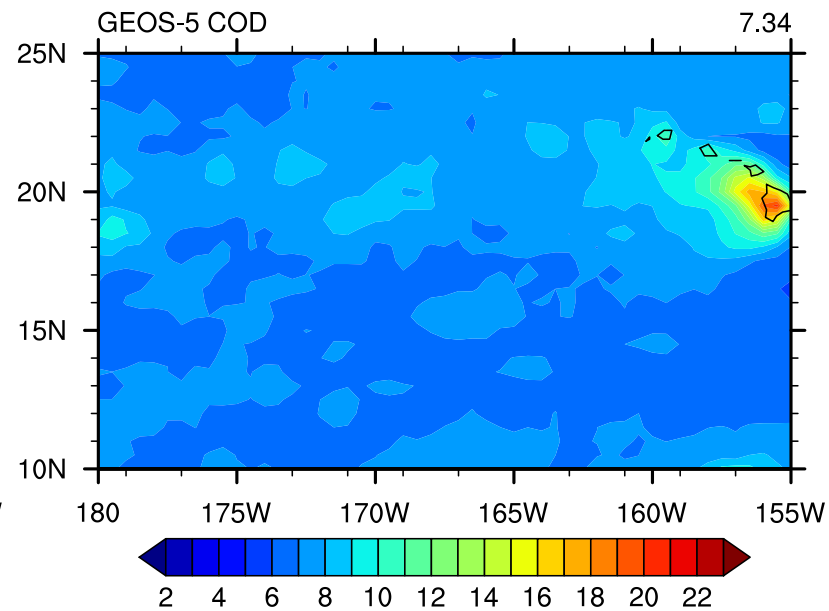
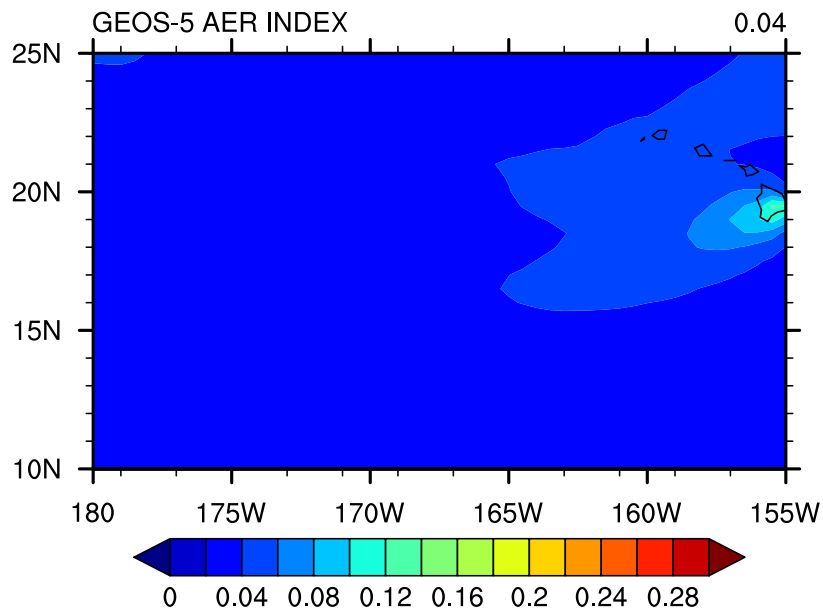
CRE EOF mode 1 correlates with AOD time series best.

Can GEOS-5 (1M/2M) reproduce the effect of the Kilauea plume on cloud properties?

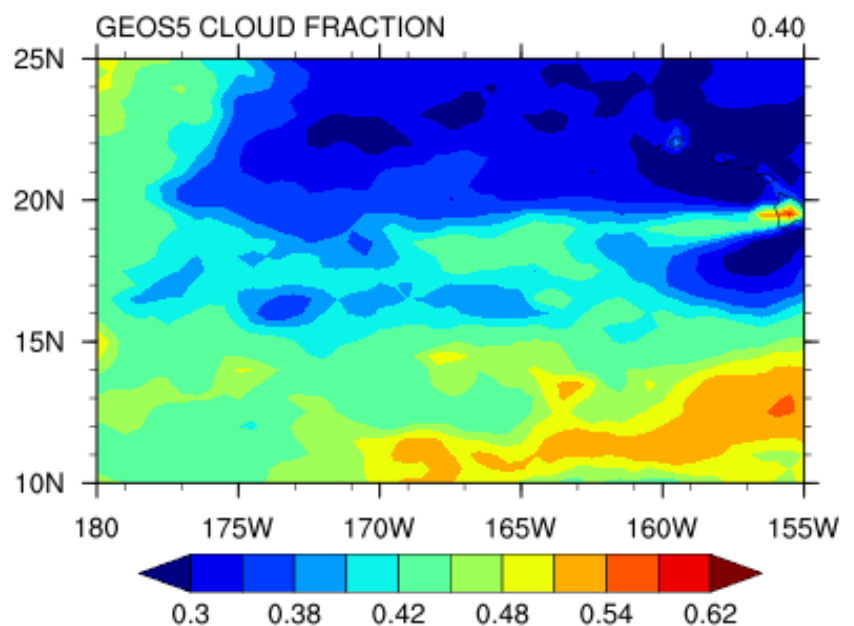
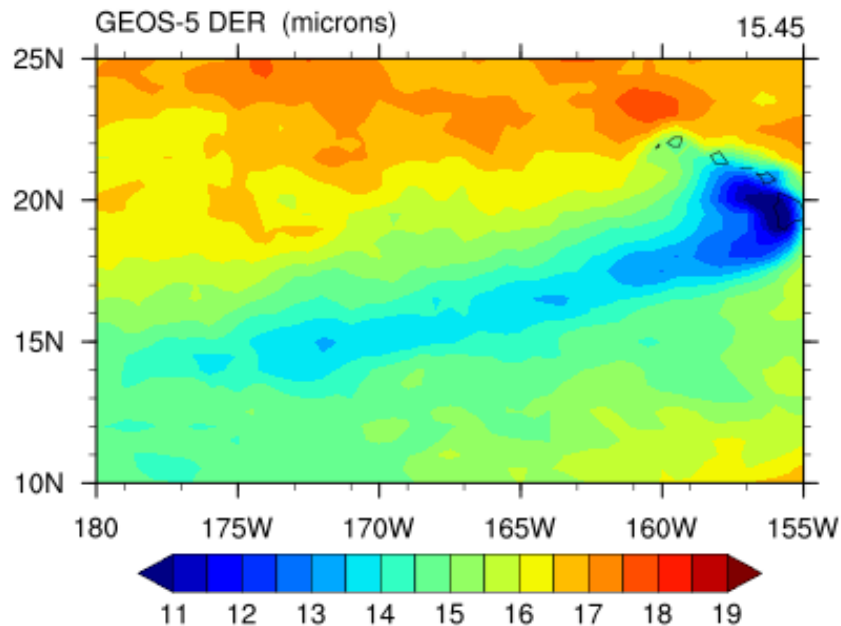
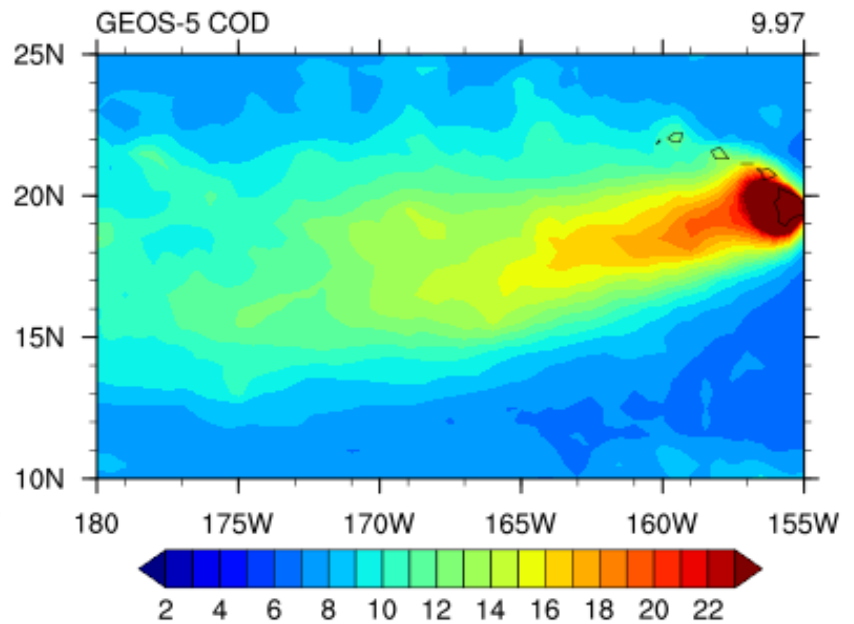
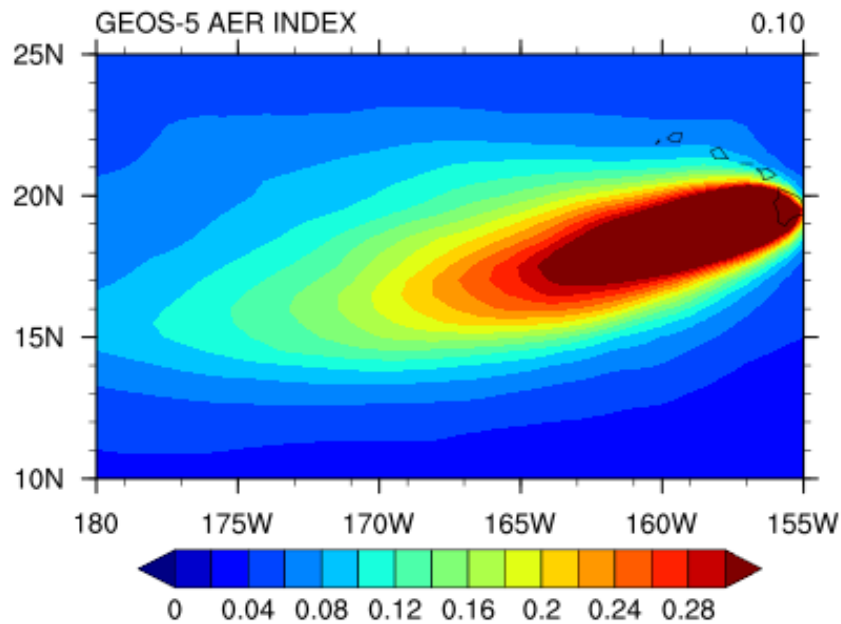
Model Setup

- Year 2008, runs at c180 resolution.
- Replay to MERRA-2 (U, V, T)
- Zero, 1X and 5X Kilauea volcanic emissions.
Taken from the USGS survey.
- Single and two-moment cloud microphysics
- Sampling using the MODIS satellite simulator
- Prescribed SST

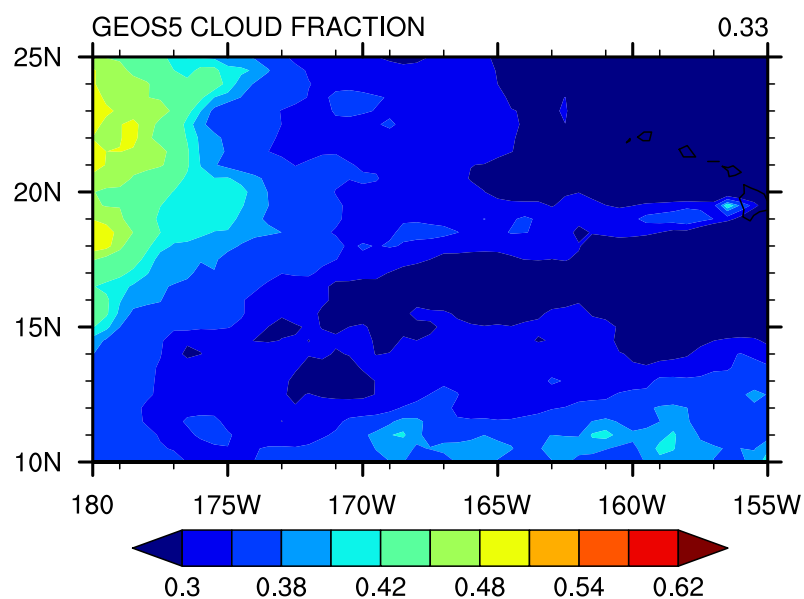
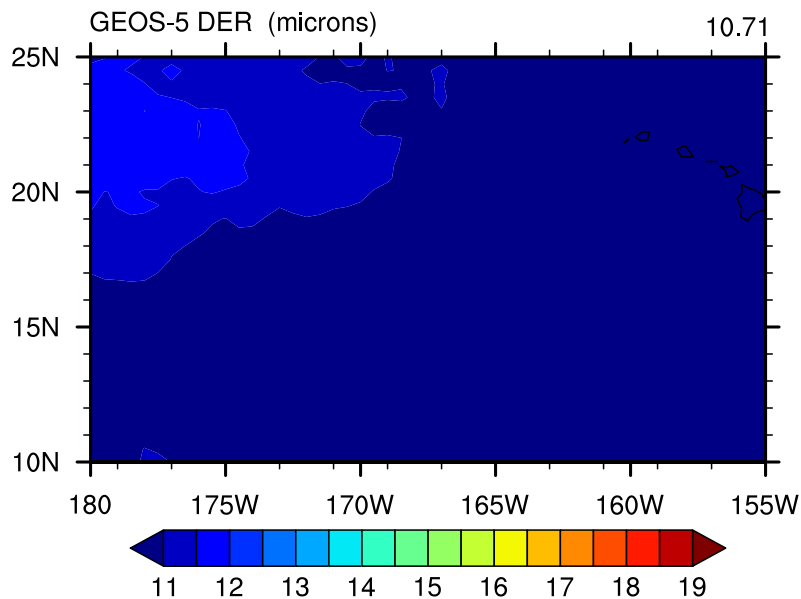
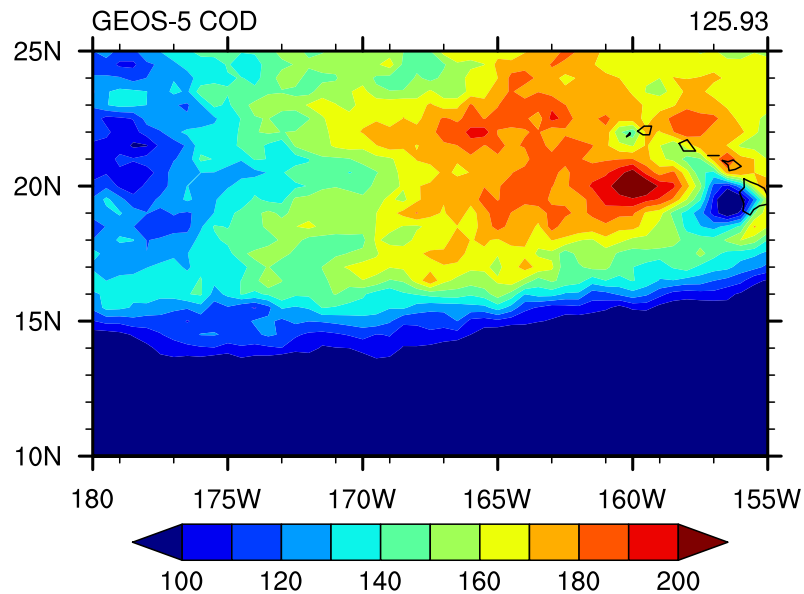
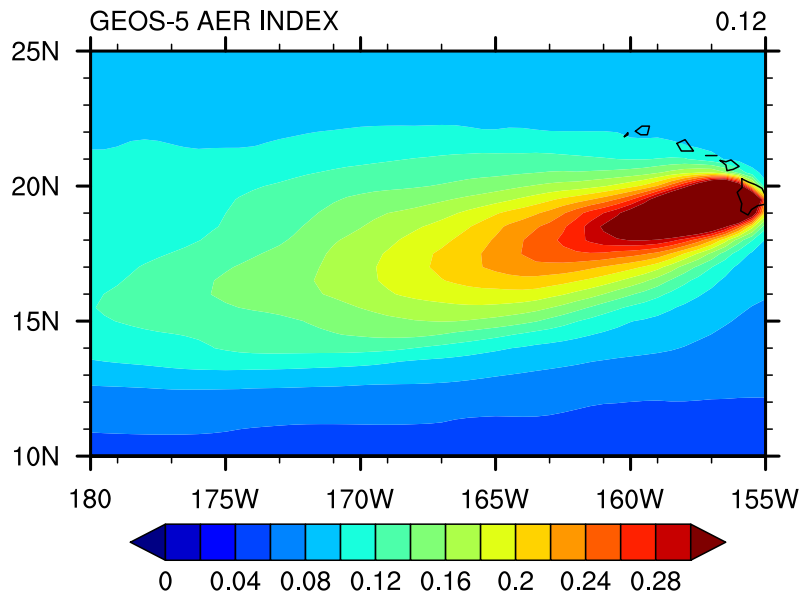
No Kilauea Emissions (JJA, 2-Moment)



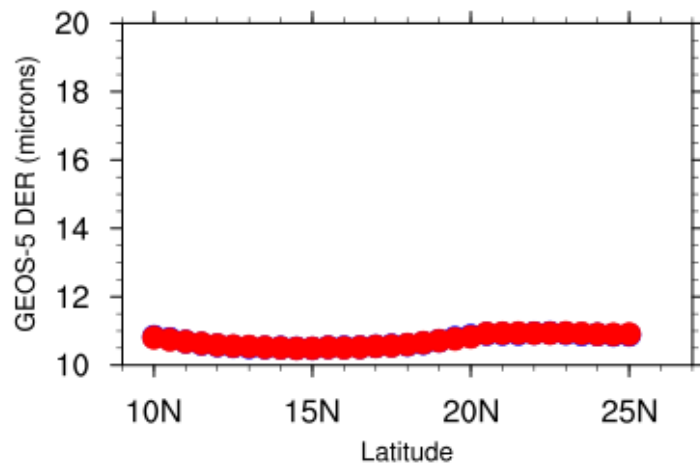
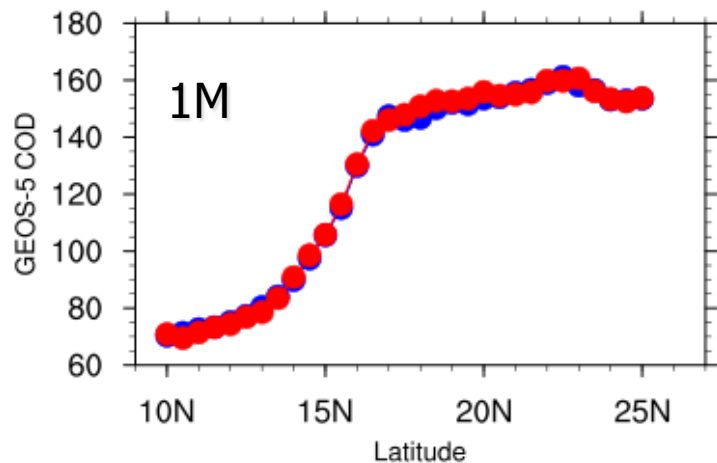
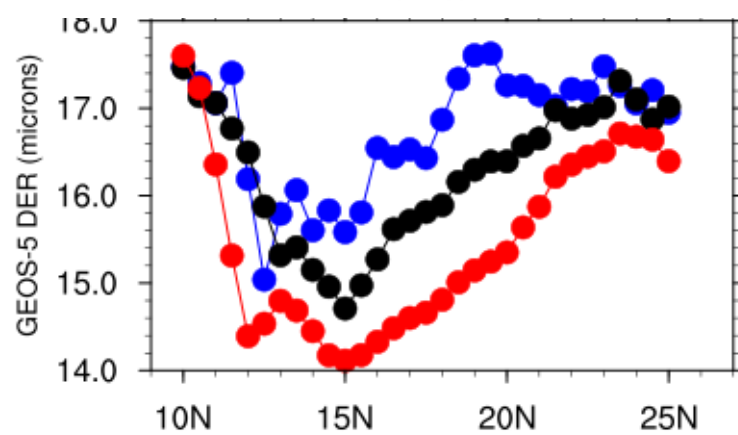
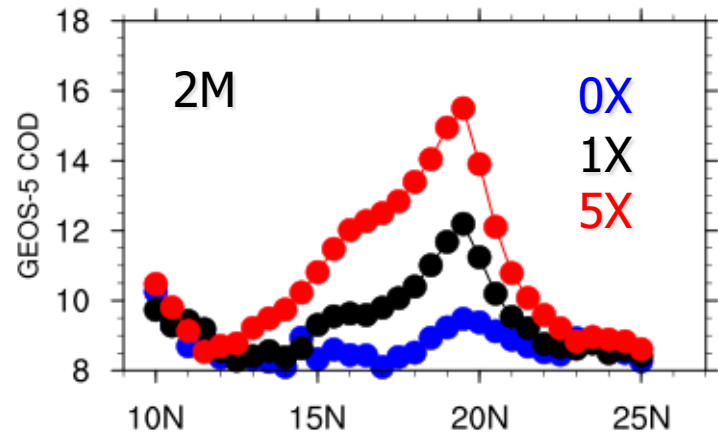
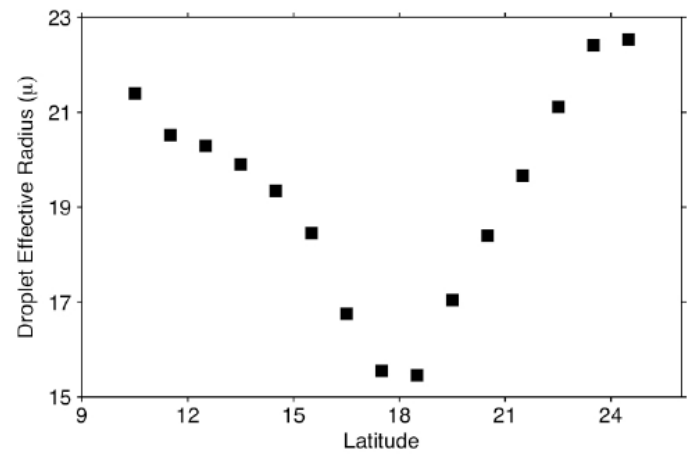
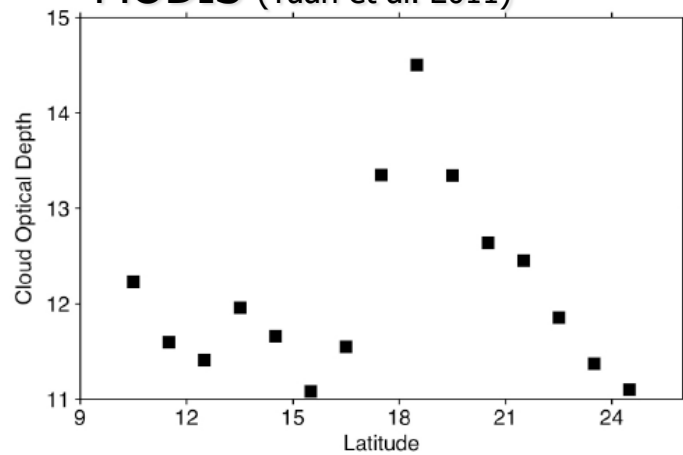
5X Kilauea Emissions (2-Moment)



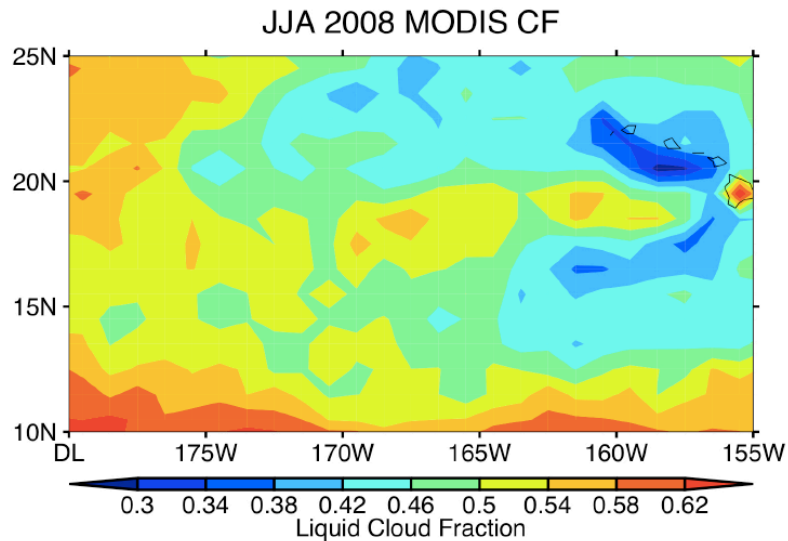
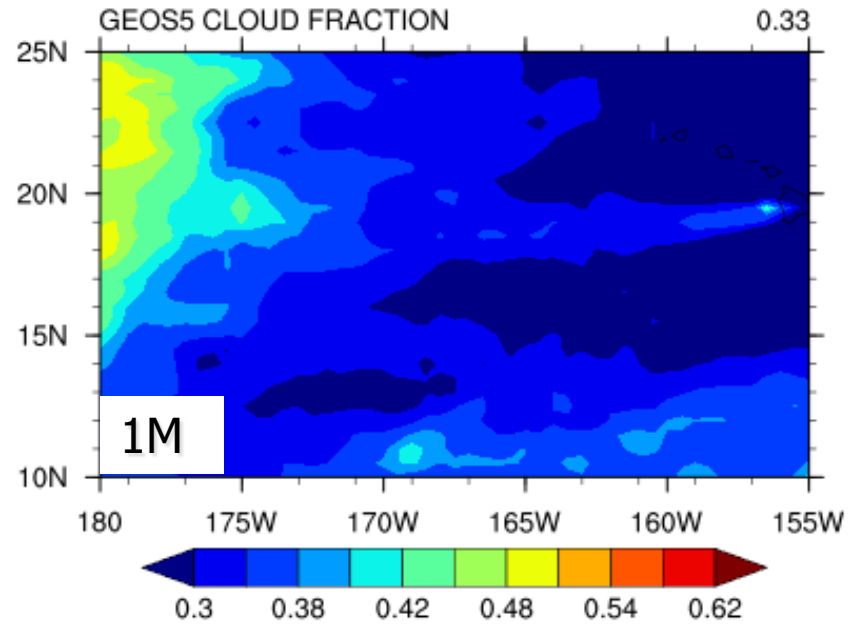
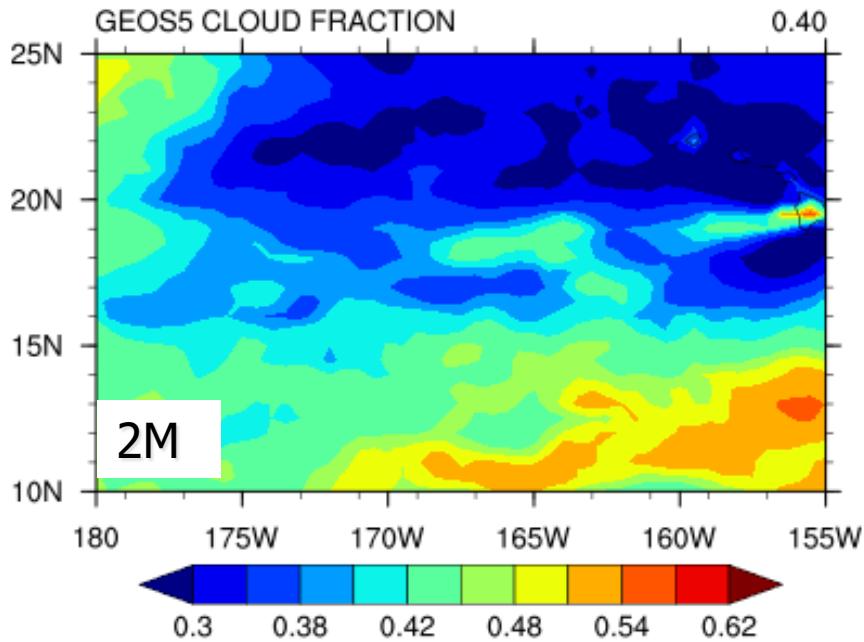
5X Kilauea Emissions (1-Moment)



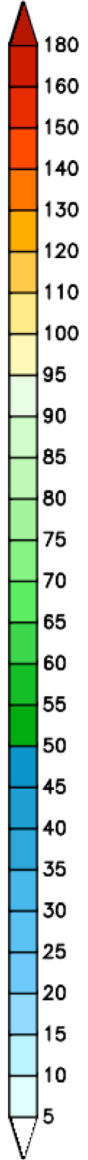
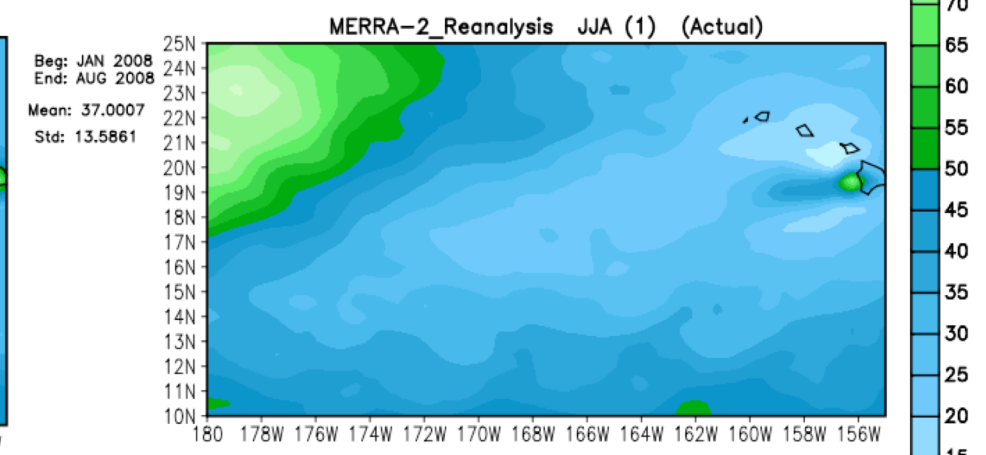
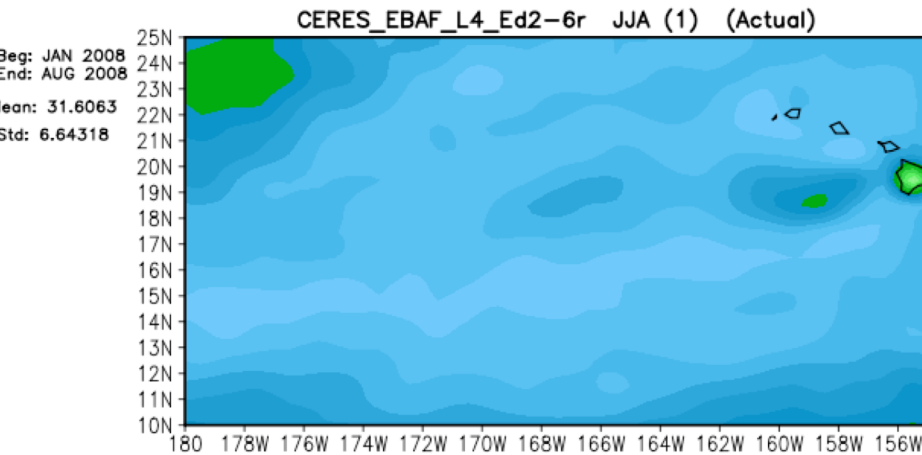
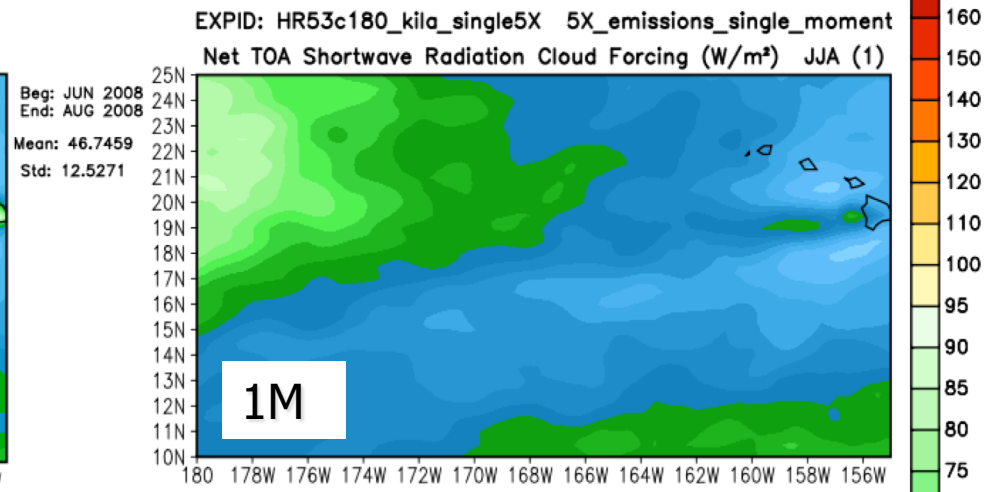
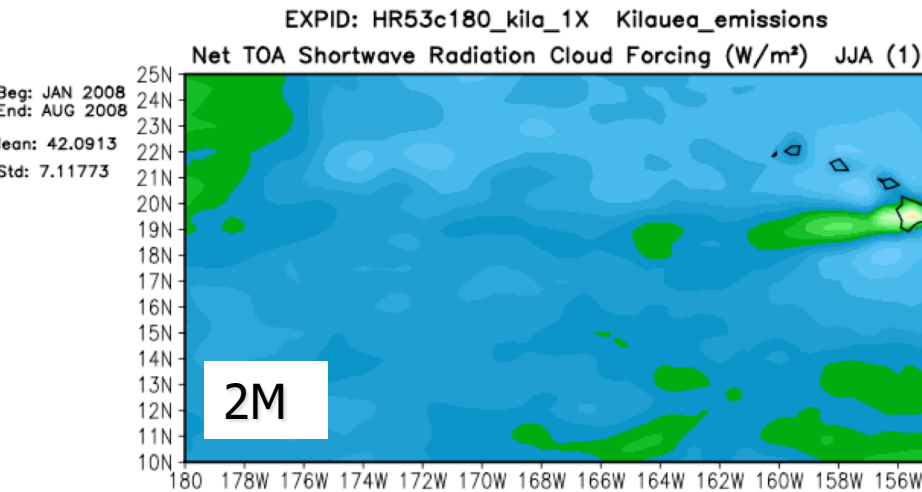
MODIS (Yuan et al. 2011)



Cloud Fraction (1X Emissions)

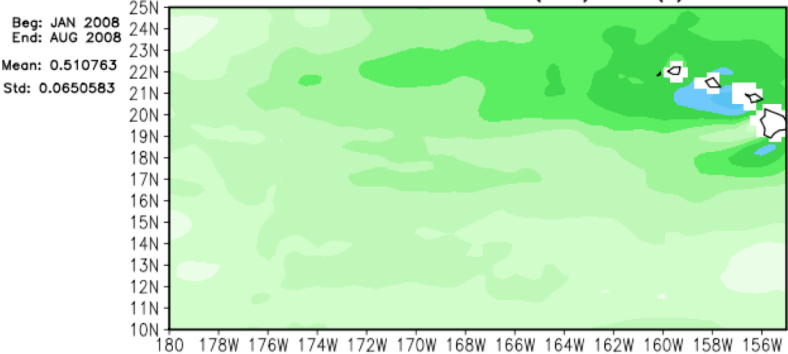


Radiative Effects (1X Emissions)

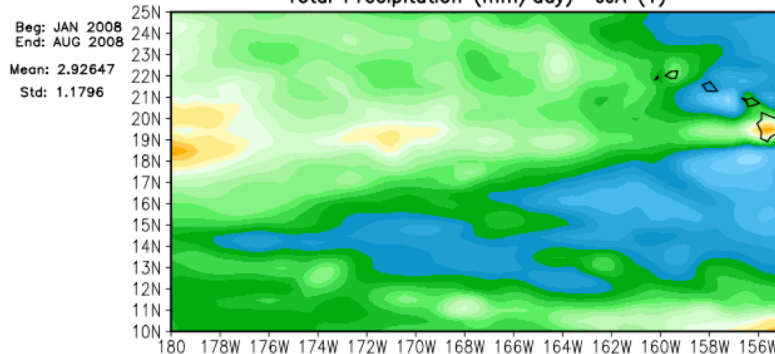


Precipitation Effects?

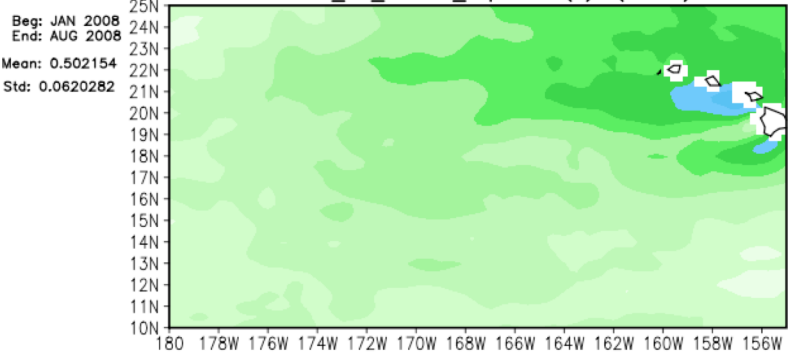
EXPID: HR53c180_kila_1X Kilauea_emissions
Total 2-D Cloud Fraction (0-1) JJA (1)



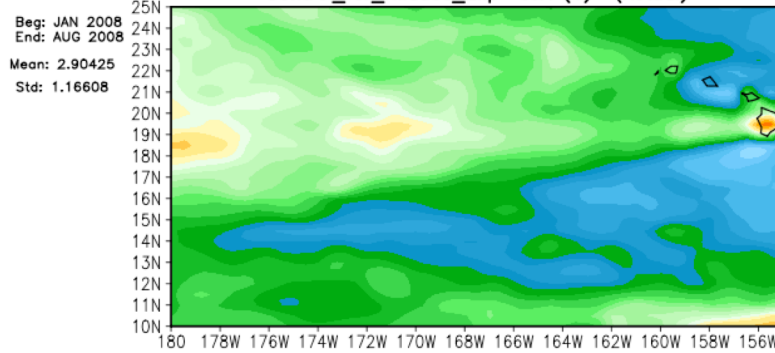
EXPID: HR53c180_kila_1X Kilauea_emissions
Total Precipitation (mm/day) JJA (1)



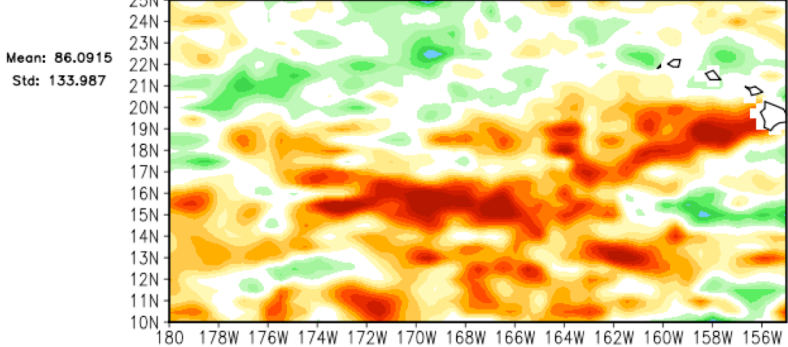
Control_for_Kilauea_Exp JJA (1) (Actual)



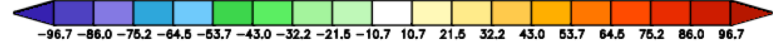
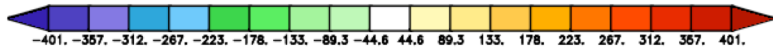
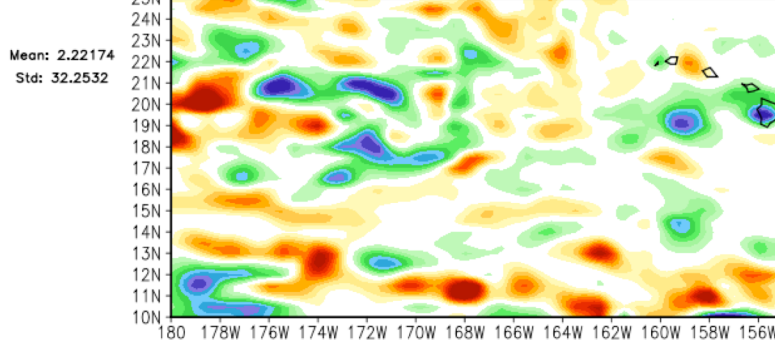
Control_for_Kilauea_Exp JJA (1) (Actual)



Difference (Top-Middle) (x 10**(-4))



Difference (Top-Middle) (x 10**(-2))



Our next step is to compile a suite of observational and meteo data sets for obs-model comparison.

