

Diverse Arctic Oscillation responses after volcanic eruptions at different latitudes during the last millennium

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Introduction

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COMMUNITY EARTH SYSTEM MODEL
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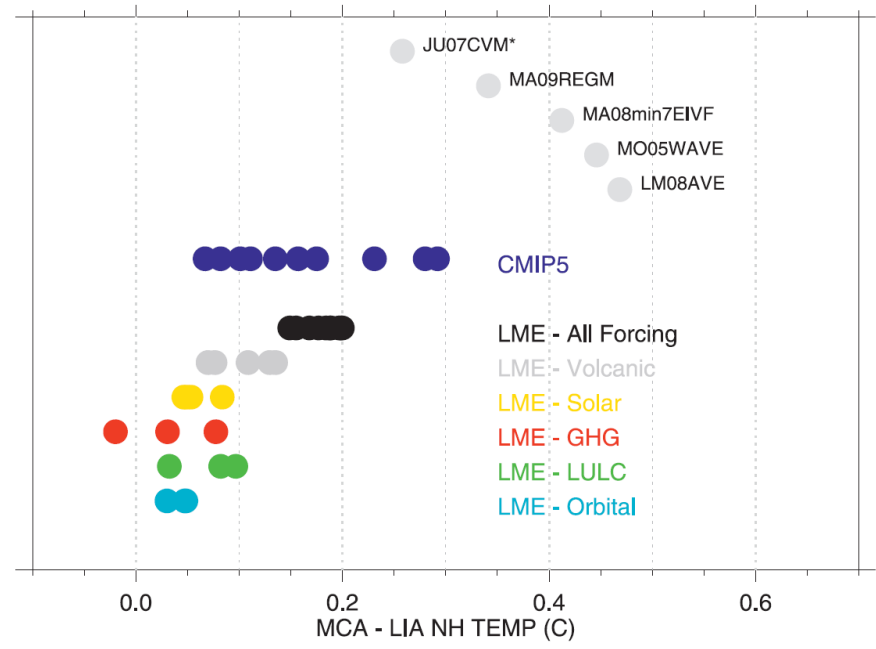
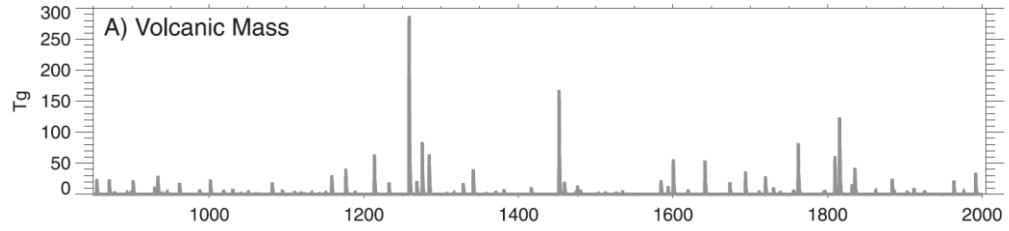
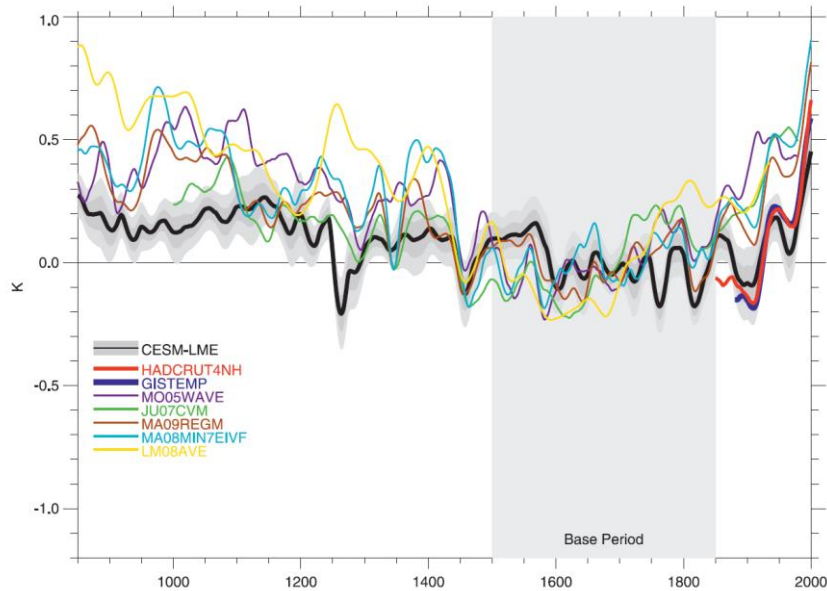
ADMINISTRATIVE

CESM Models / CESM Projects / Community Projects / Last Millennium Ensemble

LME | Last Millennium Ensemble Project

The CESM Paleoclimate Working Group at NCAR conducted a series of Last Millennium community experiments, referred to as the Last Millennium Ensemble (LME). The LME used a ~2-degree atmosphere and land, ~1-degree ocean and sea ice version of CESM-CAM5_CN (19x2.5_gxlv0). Ensemble members extend from 850 to 2006 using reconstructions for the transient evolution of solar intensity, volcanic emissions, greenhouse gases, aerosols, land use conditions, and orbital parameters, together and individually. We have completed 36 simulations for the LME project: 13 simulations with all transient forcings, smaller ensembles with each transient forcing separately, and long 1850 and 850 control simulations. Ensemble spread is generated using round-off differences in the initial atmospheric state. Monthly, daily, and 6-hourly outputs are saved and archived on the Earth System Grid (<http://www.earthsystemgrid.org>) as single variable timeseries.

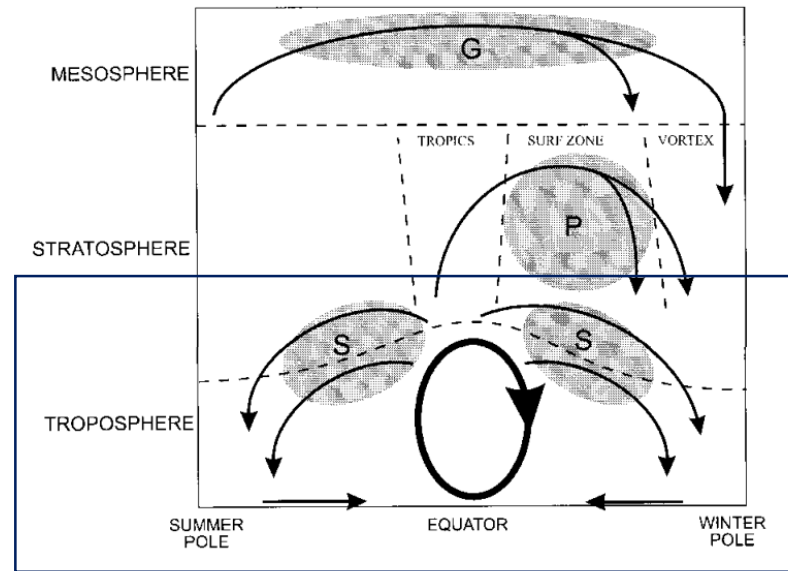
<https://www.cesm.ucar.edu/projects/community-projects/LME/>



Otto-Bliesner et al. 2016

✓ Volcanic eruptions : important role for climate change during last millennium

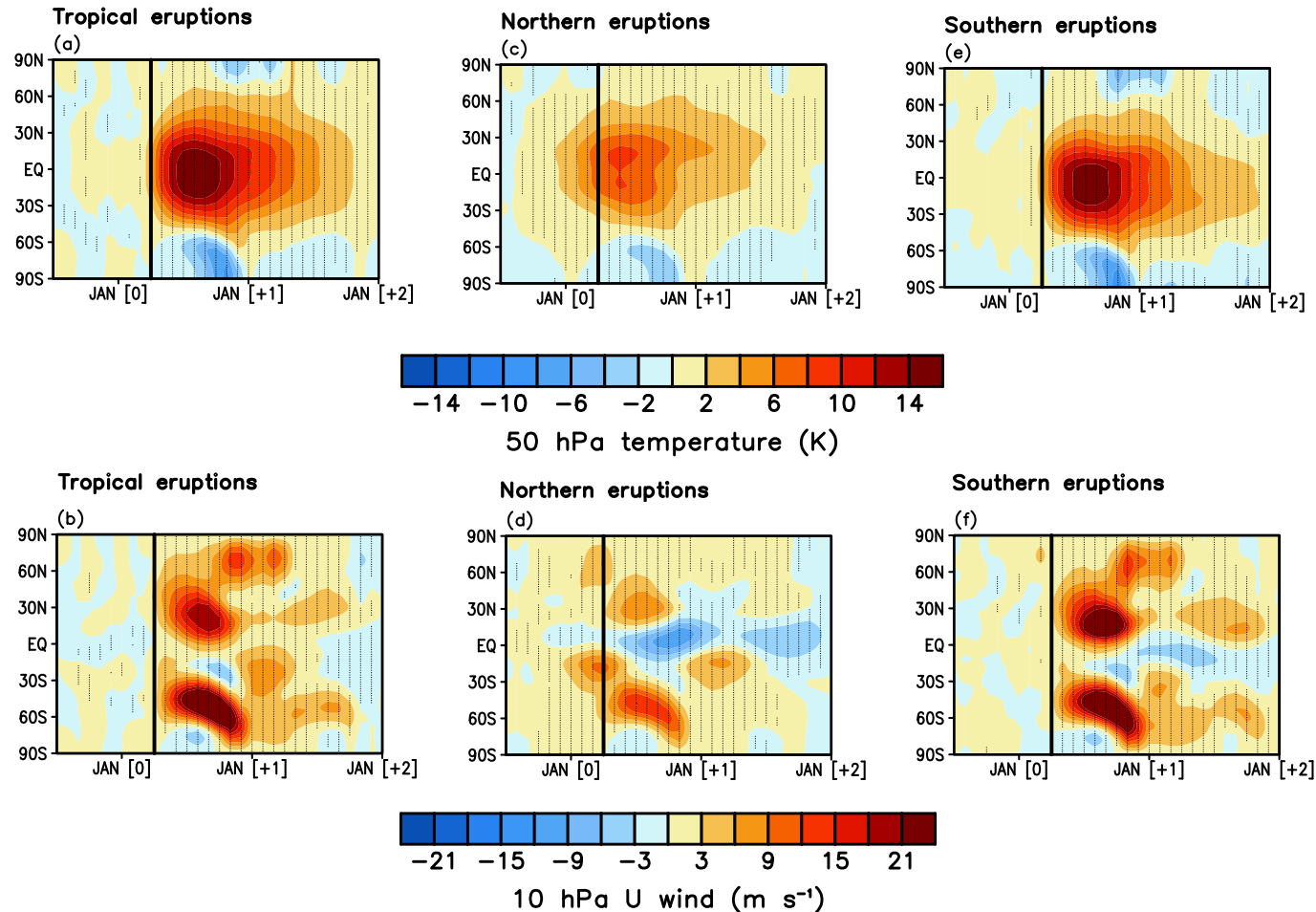
Volcanic aerosols



Plumb (2002)

- ✓ Volcanic aerosols have different meridional structures

Lower stratospheric temperature, zonal wind



Stratospheric warming → meridional temp. gradient → **subtropical westerly winds**

→ equatorward wave propagation → less waves break at high.-lats.

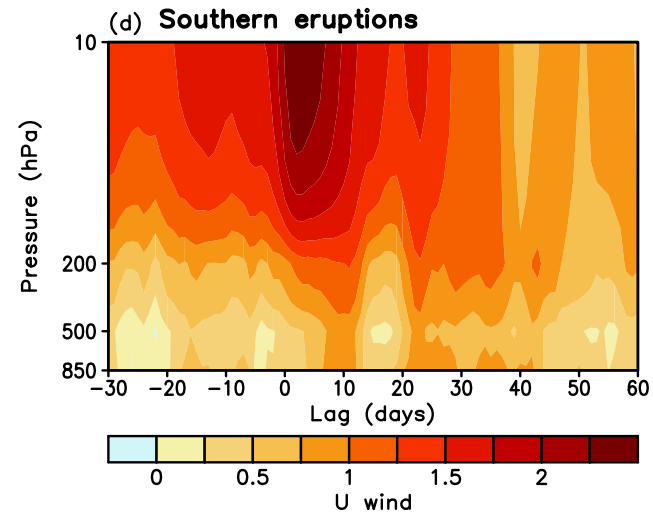
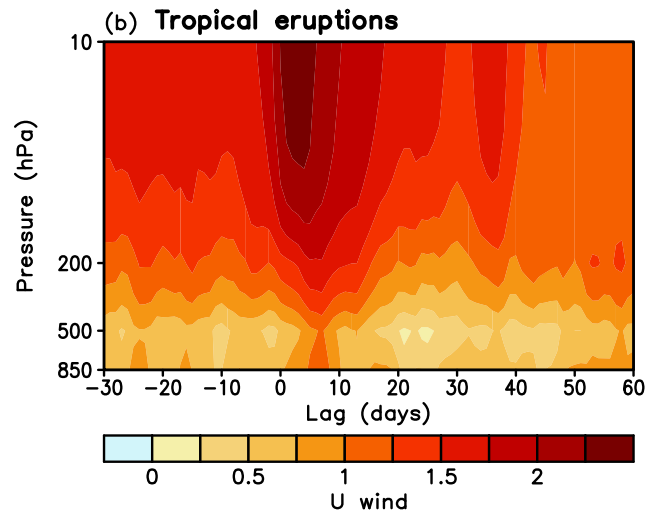
→ **Arctic polar vortex**

: strongly shown after **tropical, southern eruptions**

(Southern eruption has greater tendencies)

❖ Northern eruptions have much weaker responses (weaker temp.-gradient)

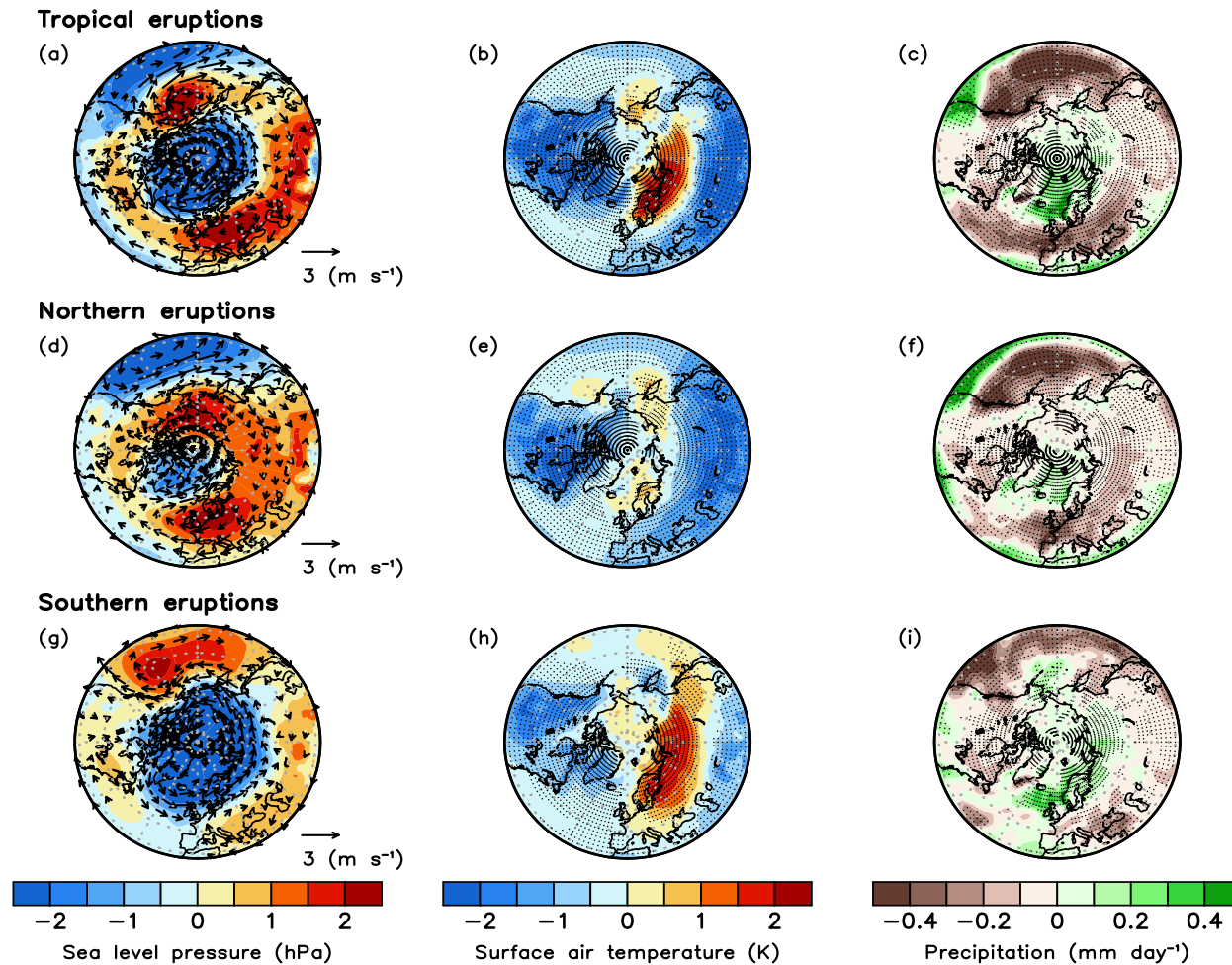
Events during DEC to FEB



Following tropical, southern eruptions,

- Arctic polar vortex enhance → propagates to lower troposphere

Winter (DJF) surface climate responses



Northern Eurasia winter warming, wetting

- ✓ Only shown following tropical and southern eruptions
- ✓ Southern eruptions have much extended responses