DEVELOPMENT OF SC-WACCM WITH THE NON-HYDROSTATIC MPAS-A DYNAMICAL CORE

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CESM - AMWG Winter Working Group Meeting

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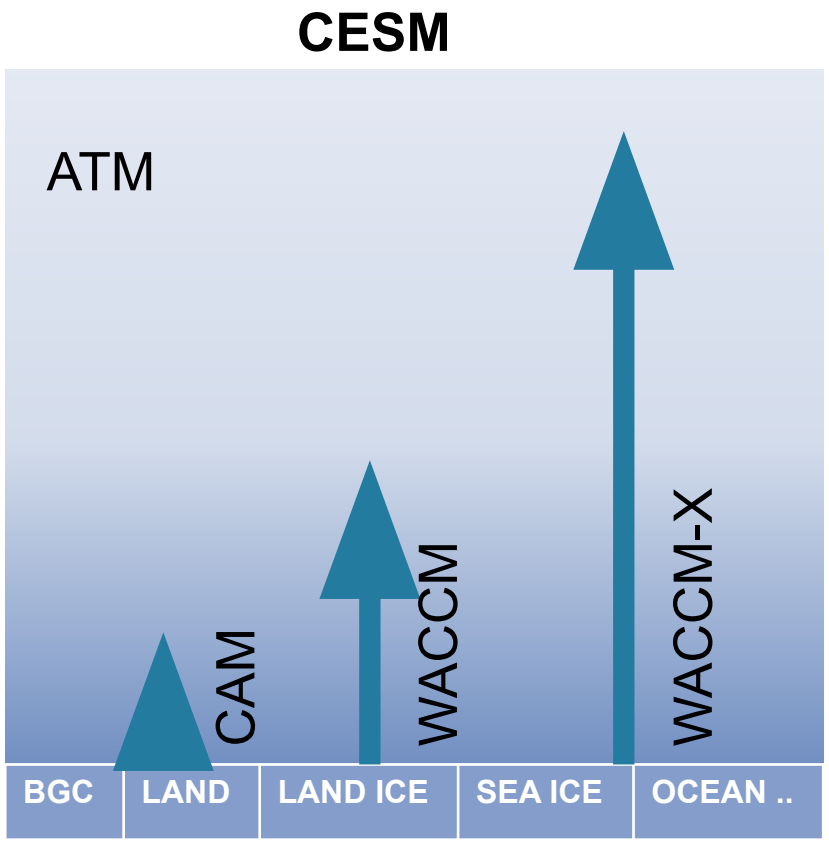
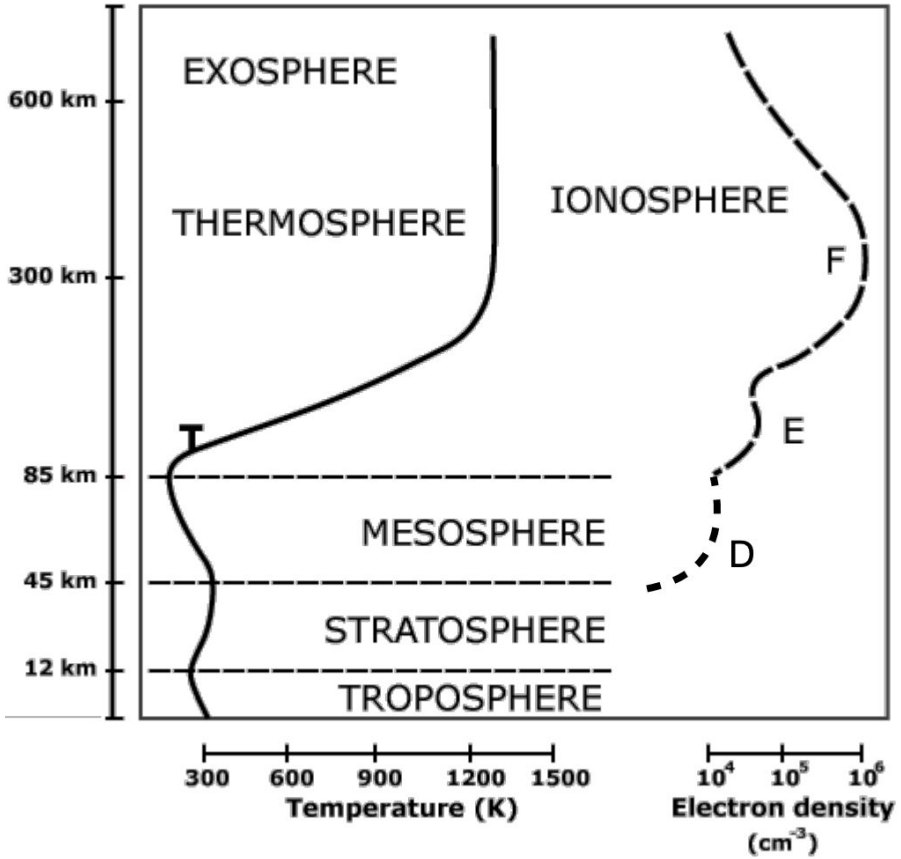
OUTLINE

- Background & Motivation
- Dynamical Cores Configuration
- Climatology Comparison
- Gravity Wave Forcing Analysis
- Conclusion & Future Work

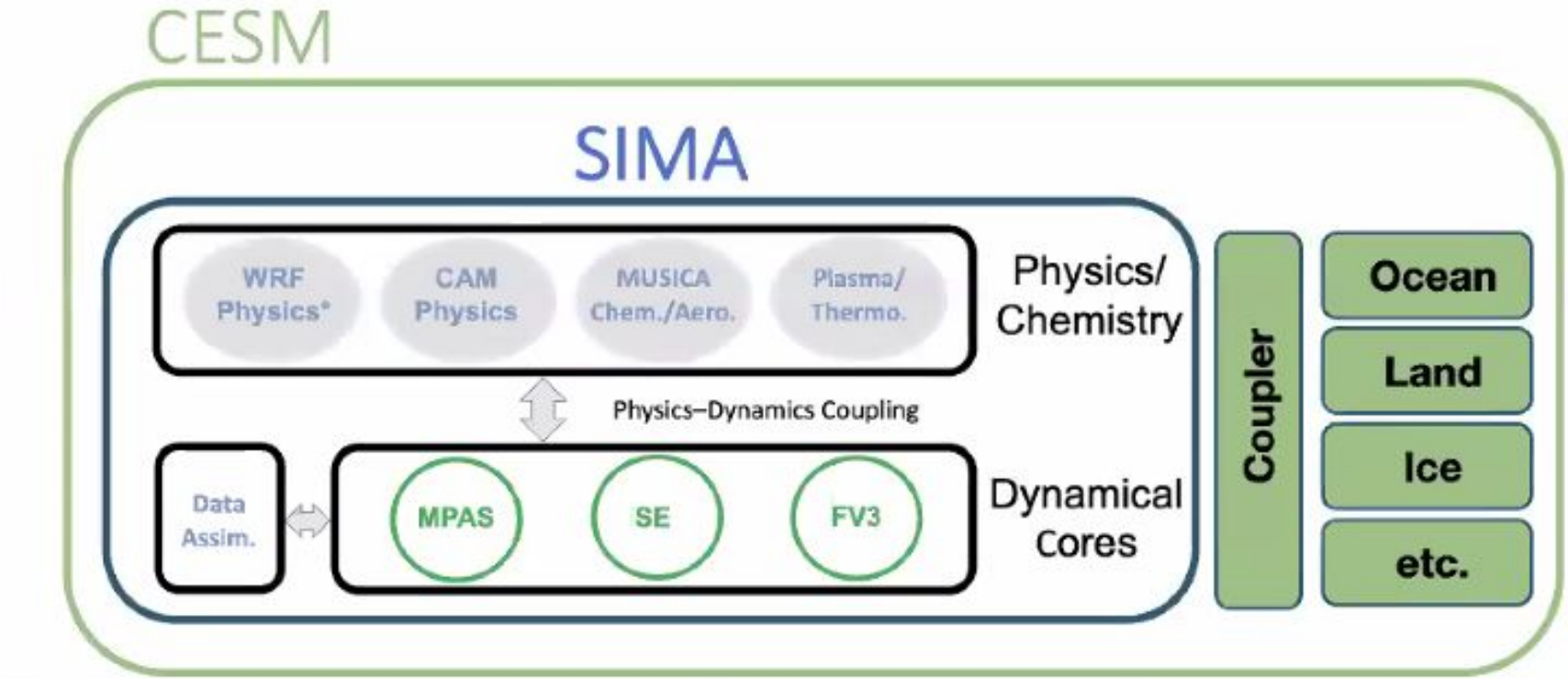
Background


CESM
ATM
CAM
WACCM
WACCM-X
BGC
LAND
LAND ICE
SEA ICE
OCEAN ..


600 km
300 km
85 km
45 km
12 km
EXOSPHERE
THERMOSPHERE
IONOSPHERE
F
E
D
MESOSPHERE
STRATOSPHERE
TROPOSPHERE
300 600 900 1200 1500
Temperature (K)
10^4 10^5 10^6
Electron density
(cm^{-3})

Motivation

System for Integrated Modeling of the Atmosphere (SIMA)



MPAS-A brings non-hydrostatic modeling capabilities to CESM.

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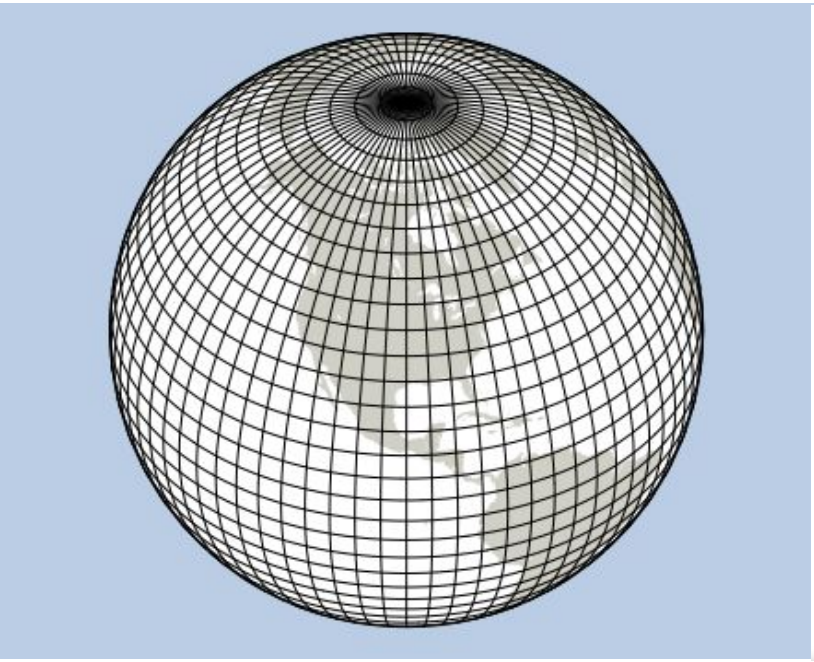
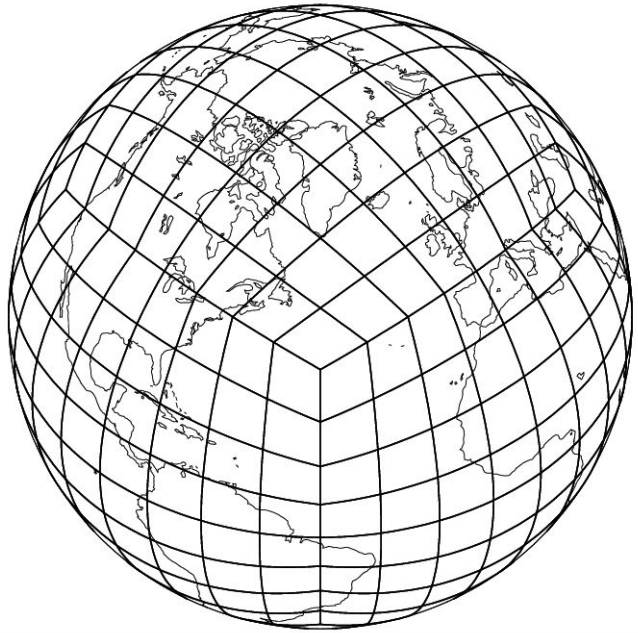
Dynamical Cores Used with WACCM

Finite Volume (FV)



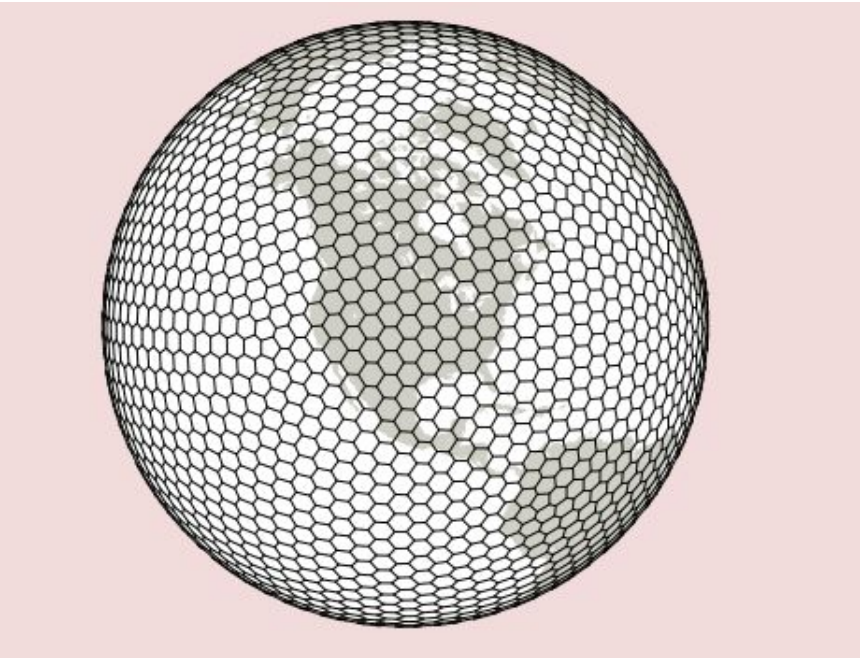
- Lat-Lon global grid, hydrostatic
- Finite-volume, D-grid staggering
- Sigma-pressure vertical coordinate

Spectral Element (SE)



- Cubed-sphere mesh, hydrostatic
- Spectral elements
- Sigma-pressure vertical coordinate

Model for Prediction Across Scale (MPAS)



- Centroidal Voronoi mesh, **nonhydrostatic**
- Finite-volume, C-grid staggering
- Hybrid terrain-following height vertical coordinate

- **SC-WACCM**
- **One year simulation on ~ 1º/100km horizontal mesh, 70 vertical levels**

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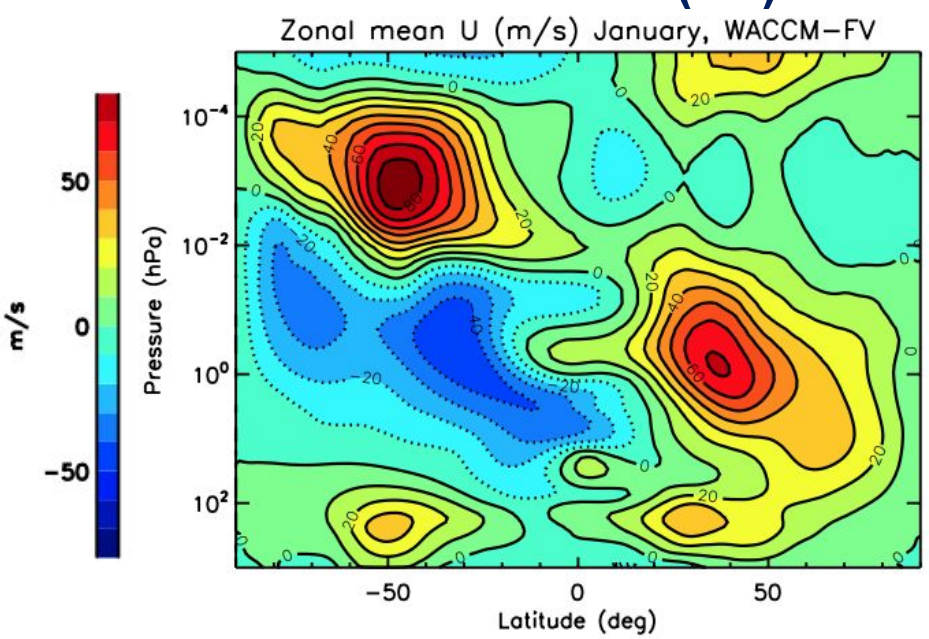
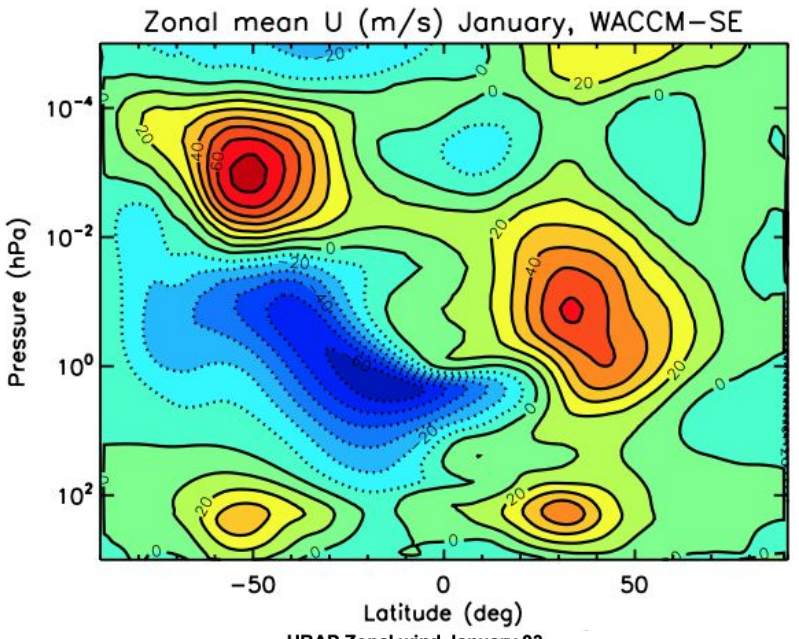
Zonal Mean Wind Climatology Comparison - January

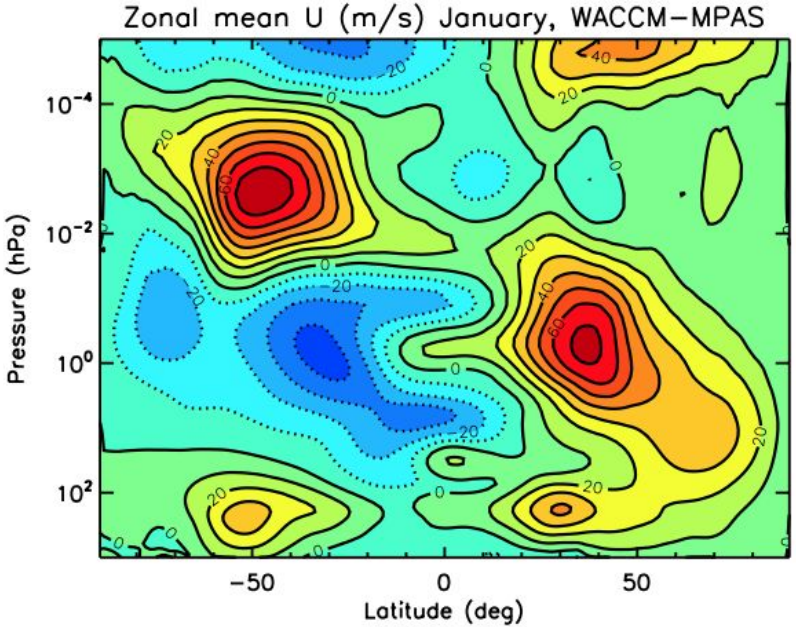
Finite Volume (FV)



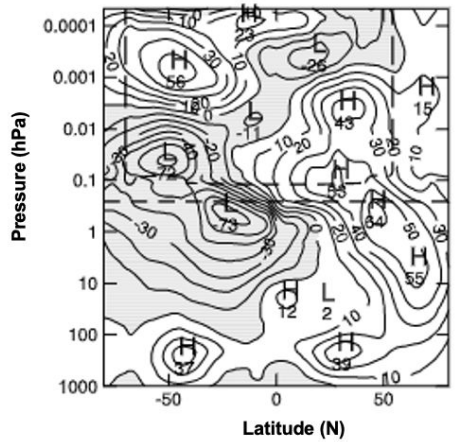
Spectral Element (SE)



MPAS-A

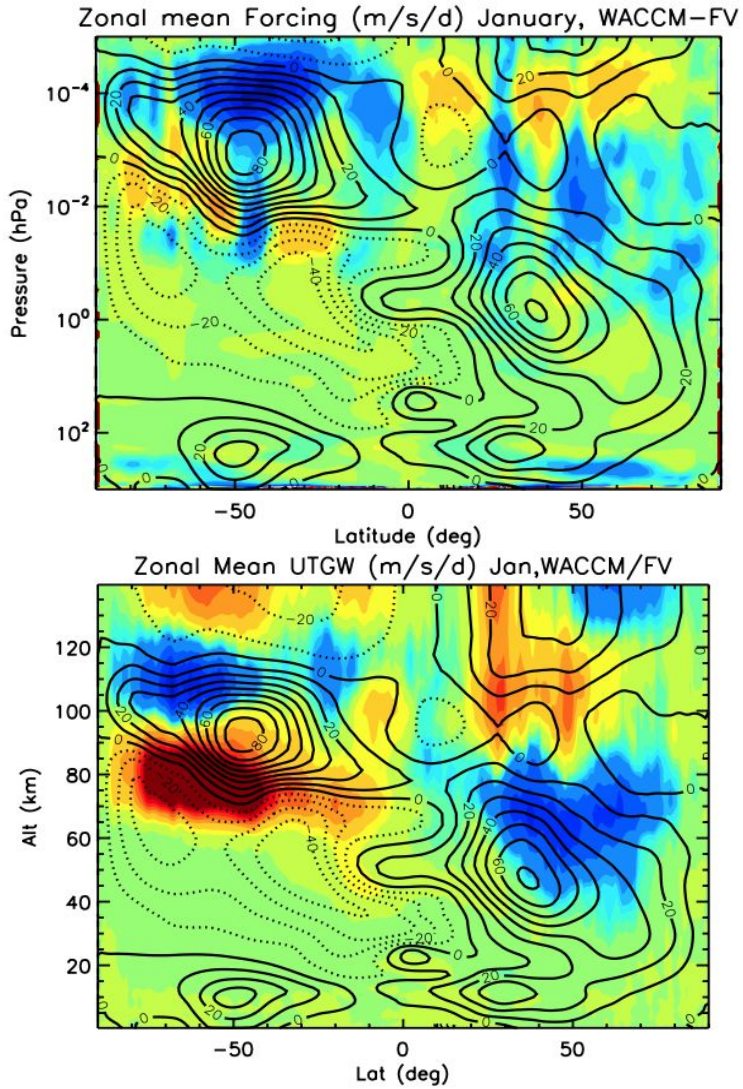


URAP Zonal wind January 93



Wave Forcing - January

Finite Volume (FV)



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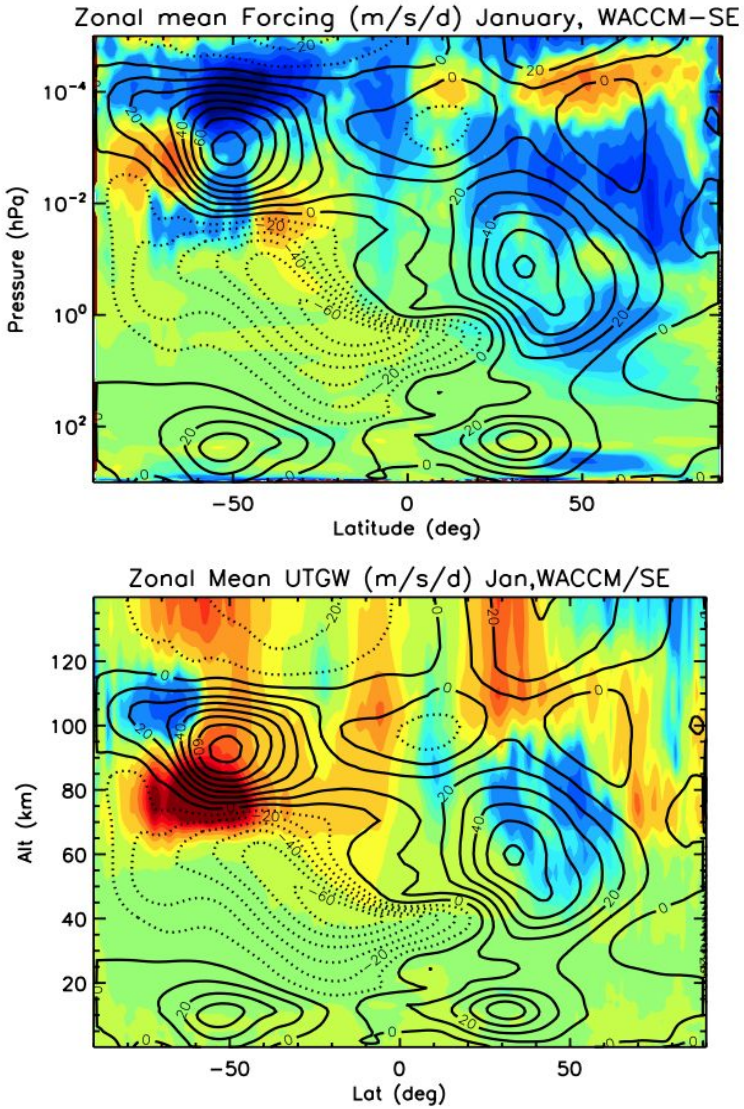
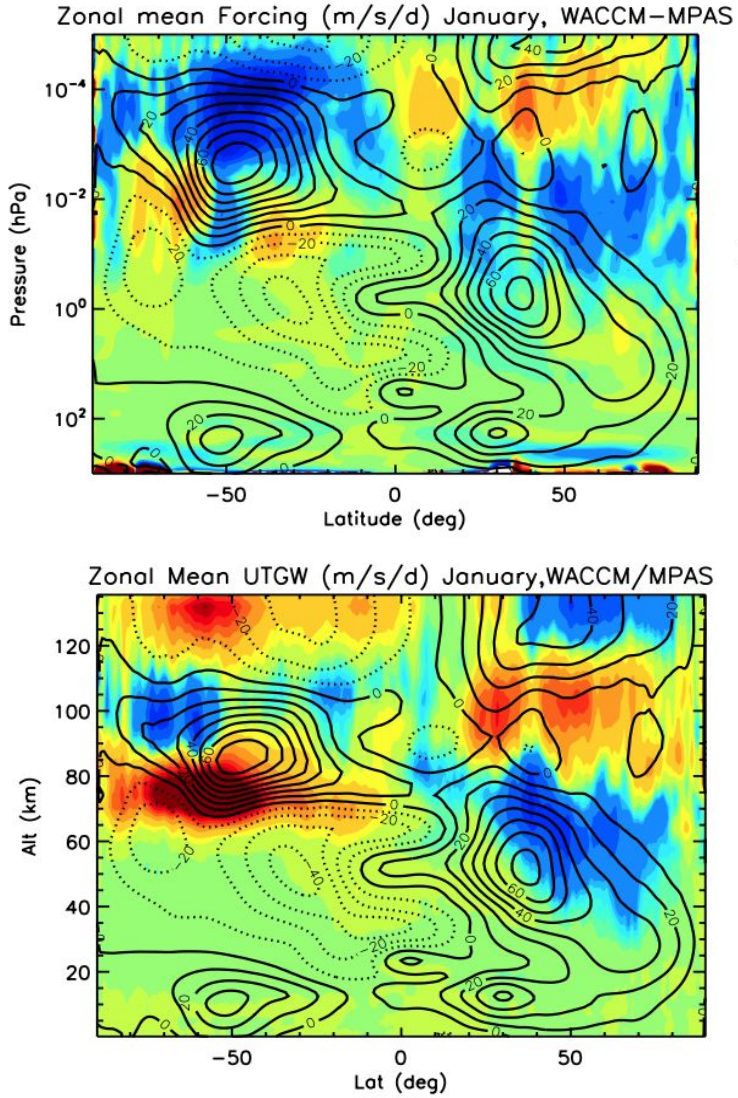
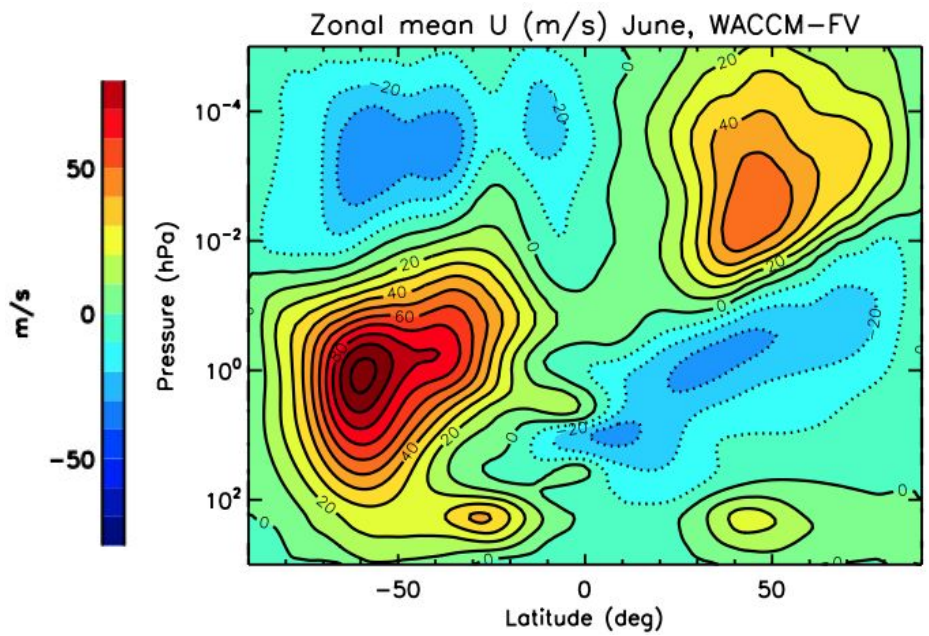


MPAS-A

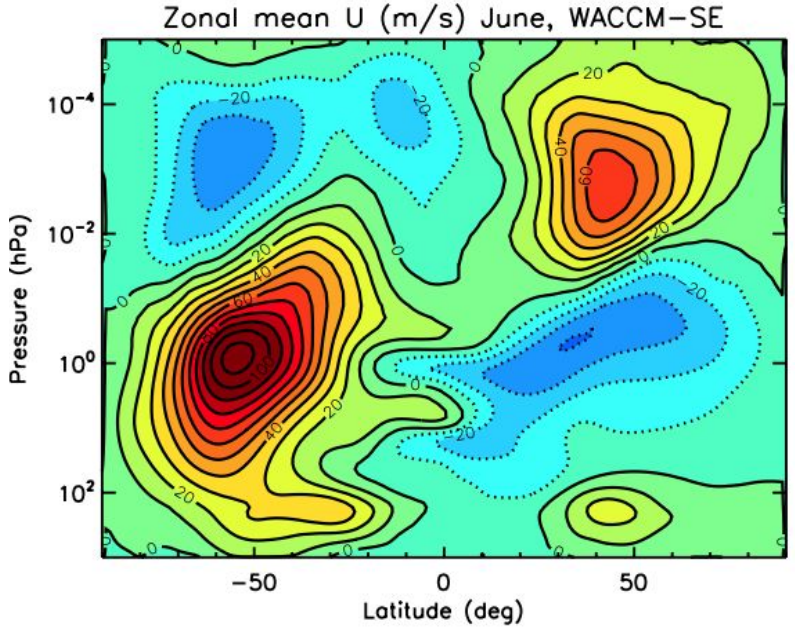


Zonal Mean Wind Climatology Comparison- June

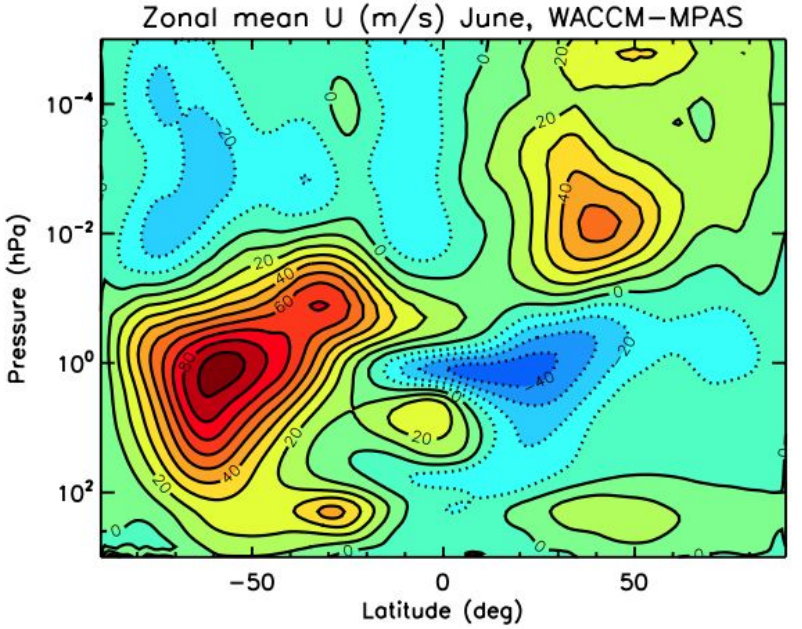
Finite Volume (FV)



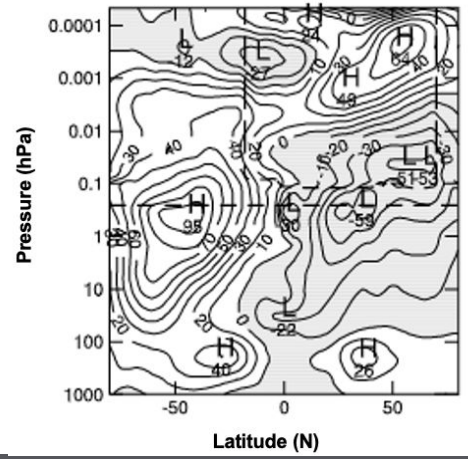
Spectral Element (SE)



MPAS-A

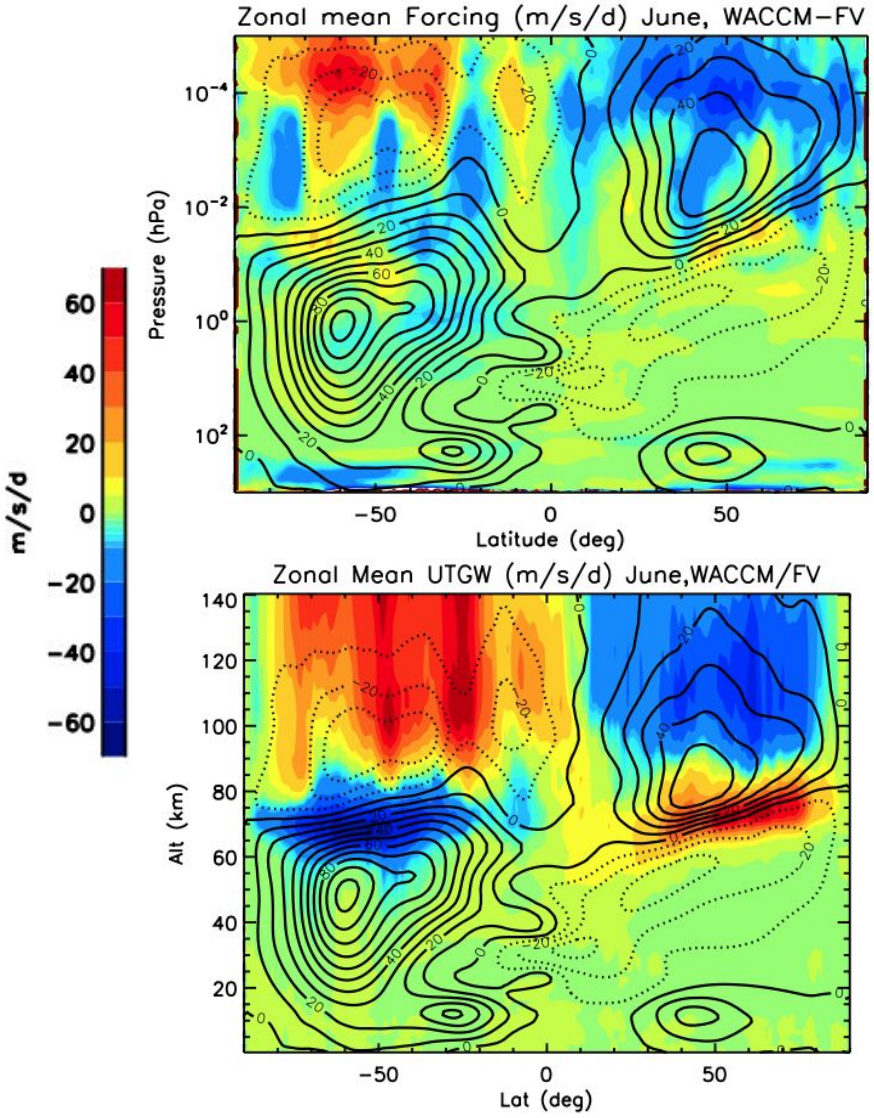


URAP Zonal wind June 92

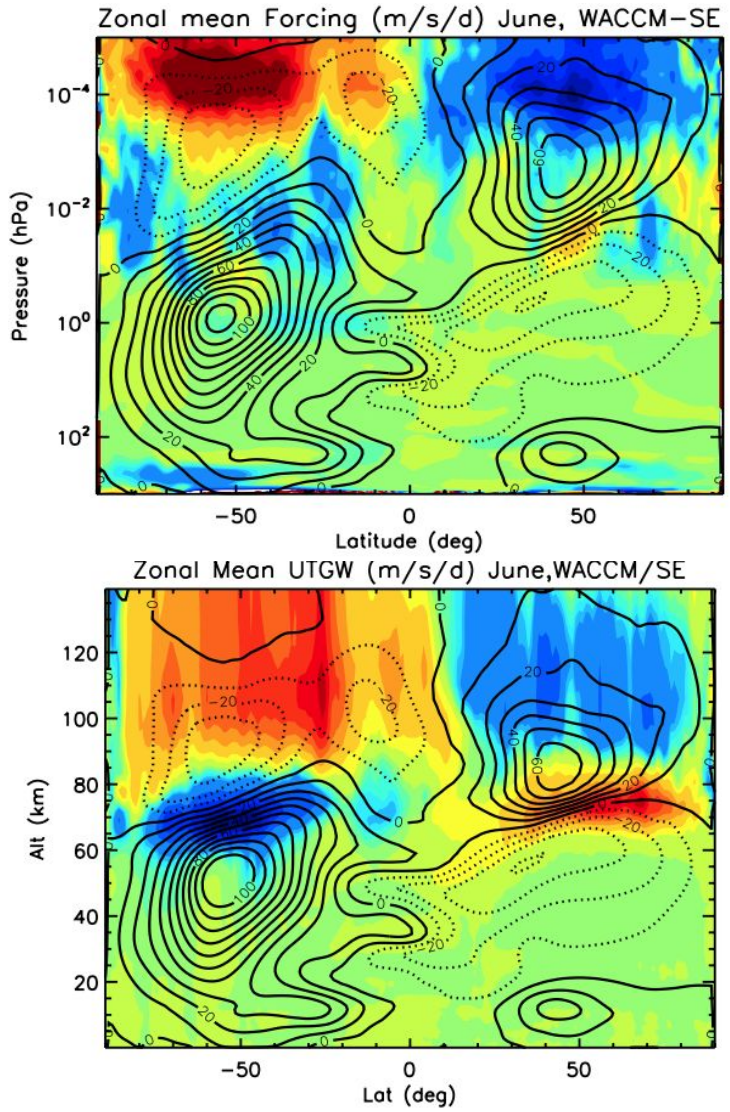


Wave Forcing - June

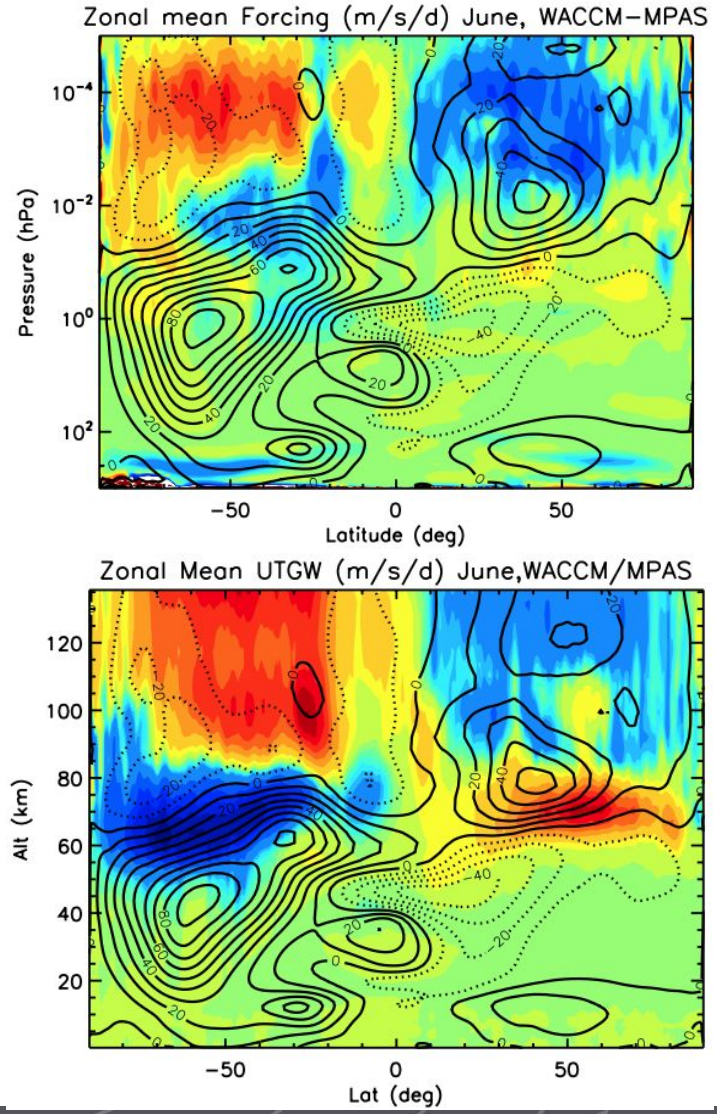
Finite Volume (FV)



Spectral Element (SE)



MPAS-A



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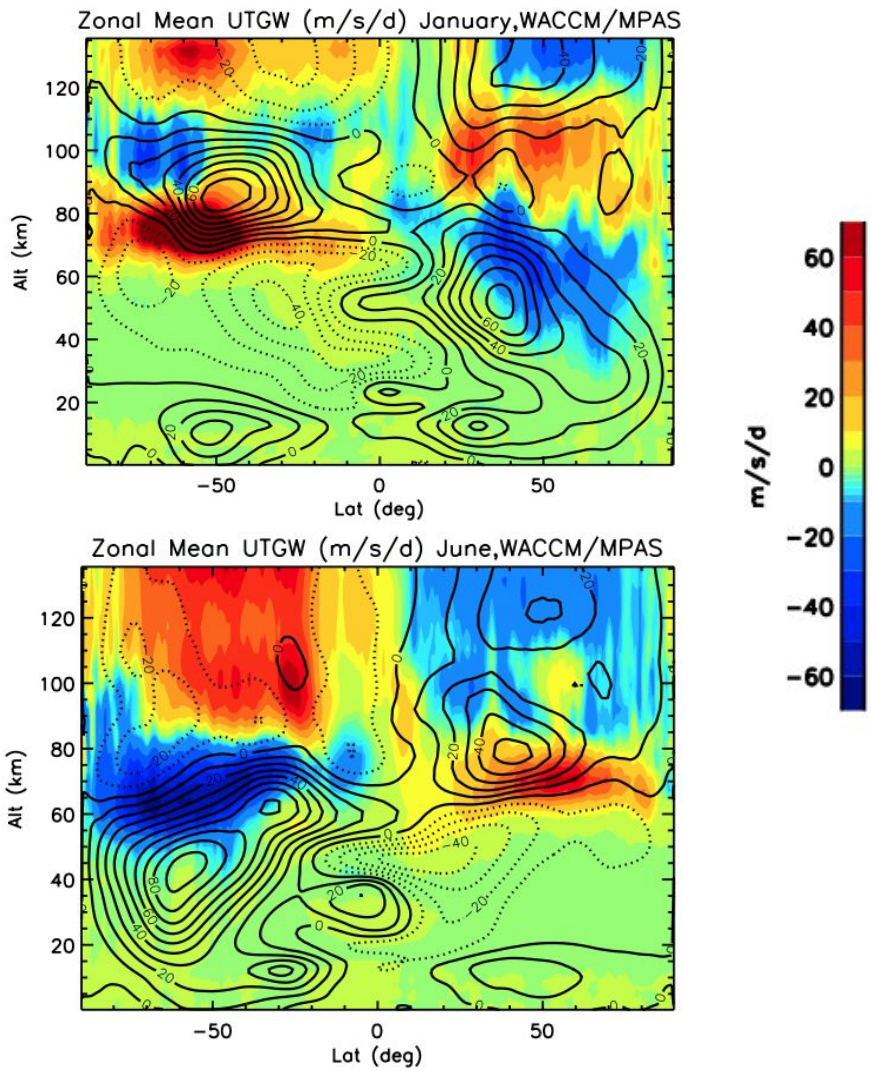
Total Parameterized Gravity Wave Forcing – June VS. January

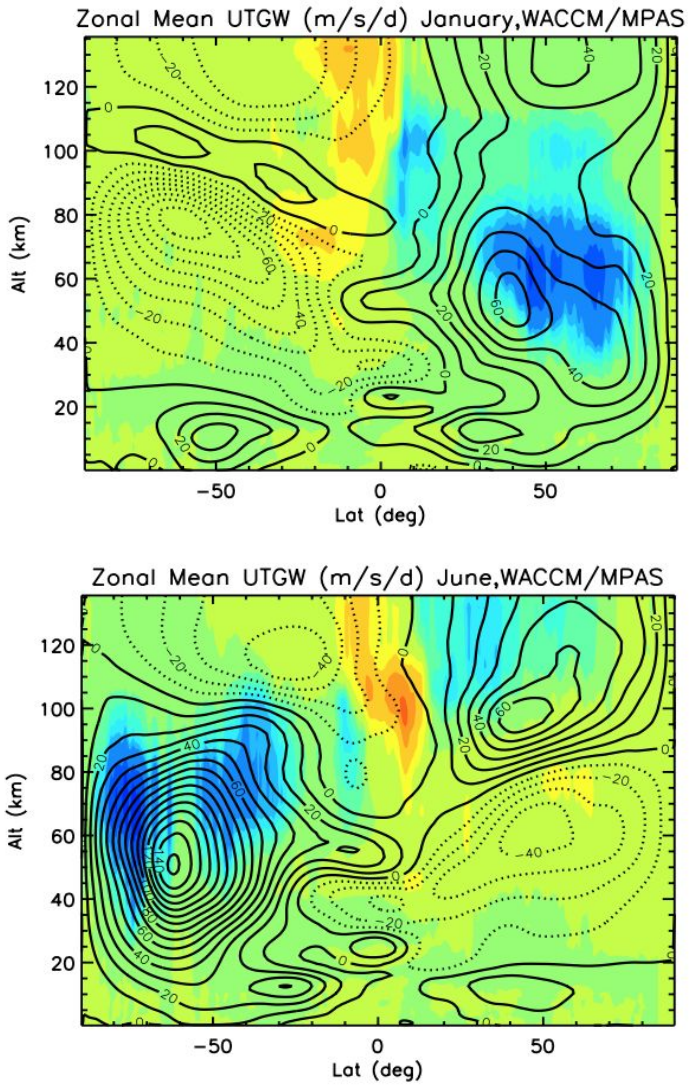
MPAS-A- All GW turned on

MPAS-A- Frontal GW turned off

January

June



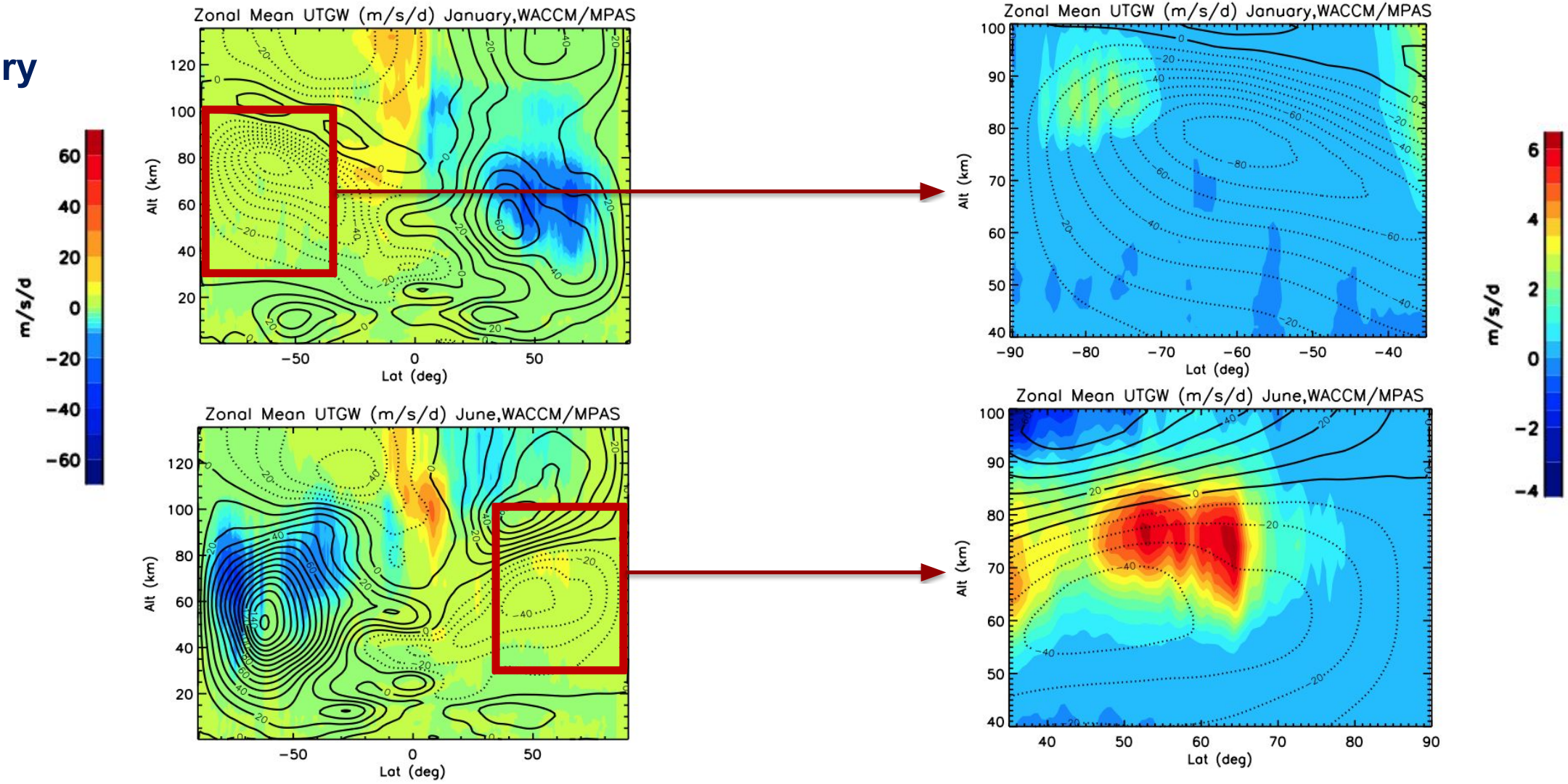


Total Parameterized Gravity Wave Forcing – June VS. January

MPAS-A- Frontal GW turned off

January

June



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Conclusion & Future Work

- As part of the **SIMA** effort we have developed and tested **WACCM** with the non-hydrostatic Model for Prediction Across Scales-Atmosphere **(MPAS-A).**

- The mean zonal wind and temperature **climatology** from **WACCM/MPAS-A** compares well with the results from WACCM using **FV** and **SE** dynamical cores.

Future work:

- Further study the effects of resolved and parametrized waves among the models.
- Perform high resolution simulations at convective scales.
- Adapt the non-hydrostatic MPAS-A to work with WACCM-X.

THANK YOU!!

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Back–up Slides

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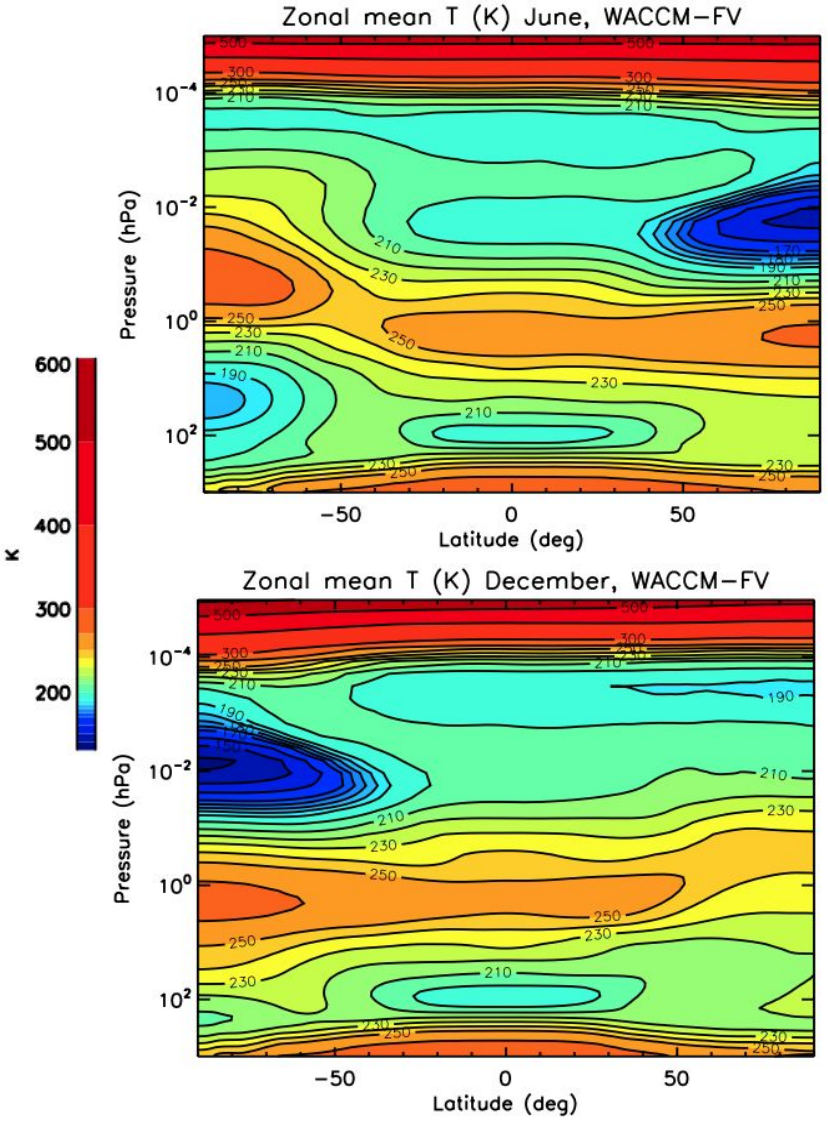
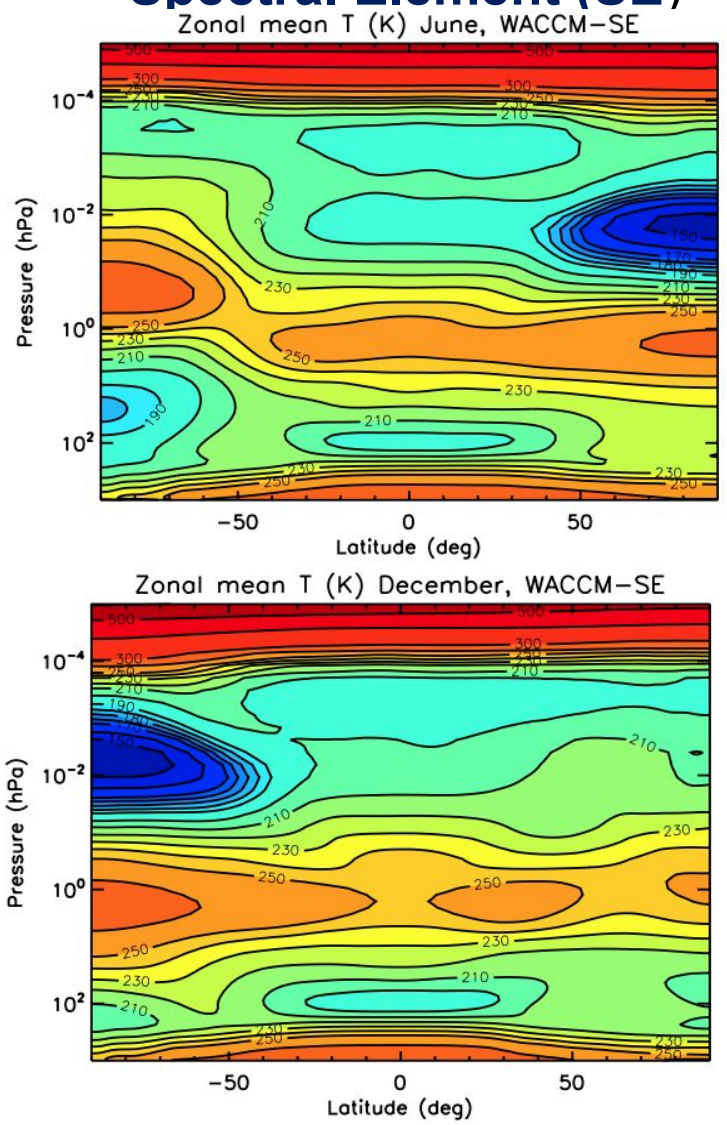
Mean Zonal Temperature Comparison

Finite Volume (FV)



Spectral Element (SE)



MPAS-A