DEVELOPMENT OF A WHOLE ATMOSPHERE MODEL WITH THE NON-HYDROSTATIC MPAS-A DYNAMICAL CORE

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OUTLINE

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

Why Whole Atmosphere Models?

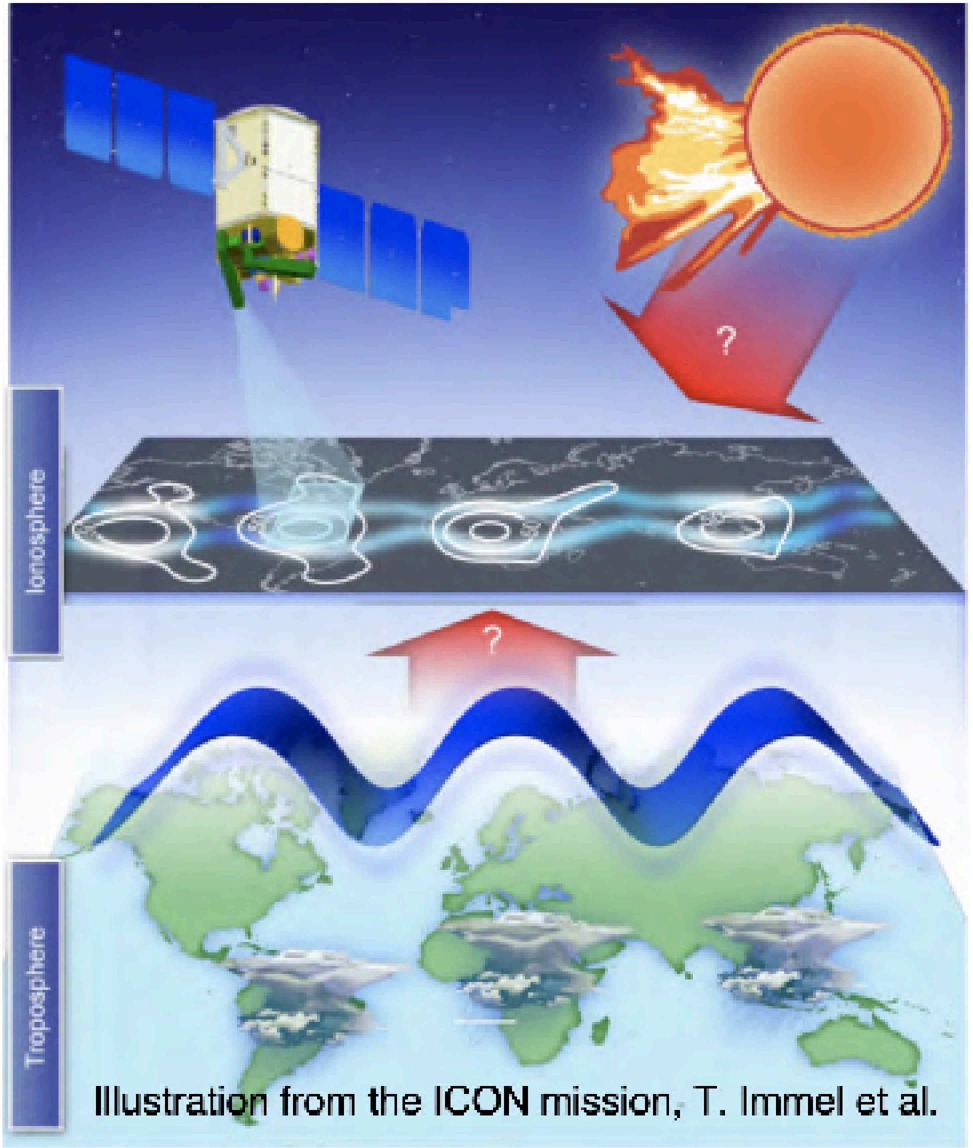
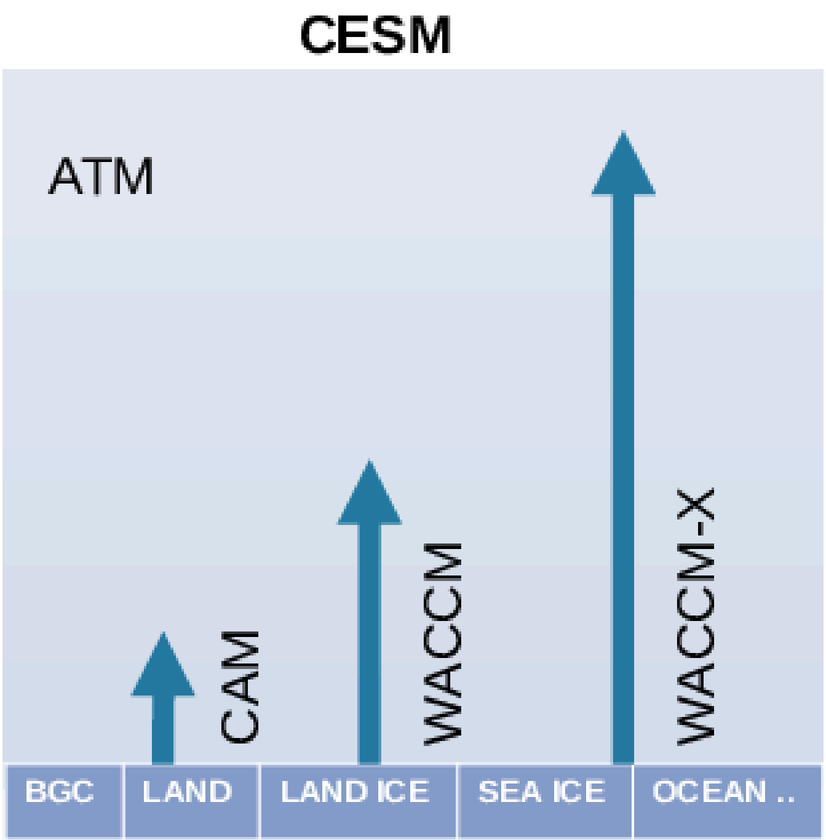
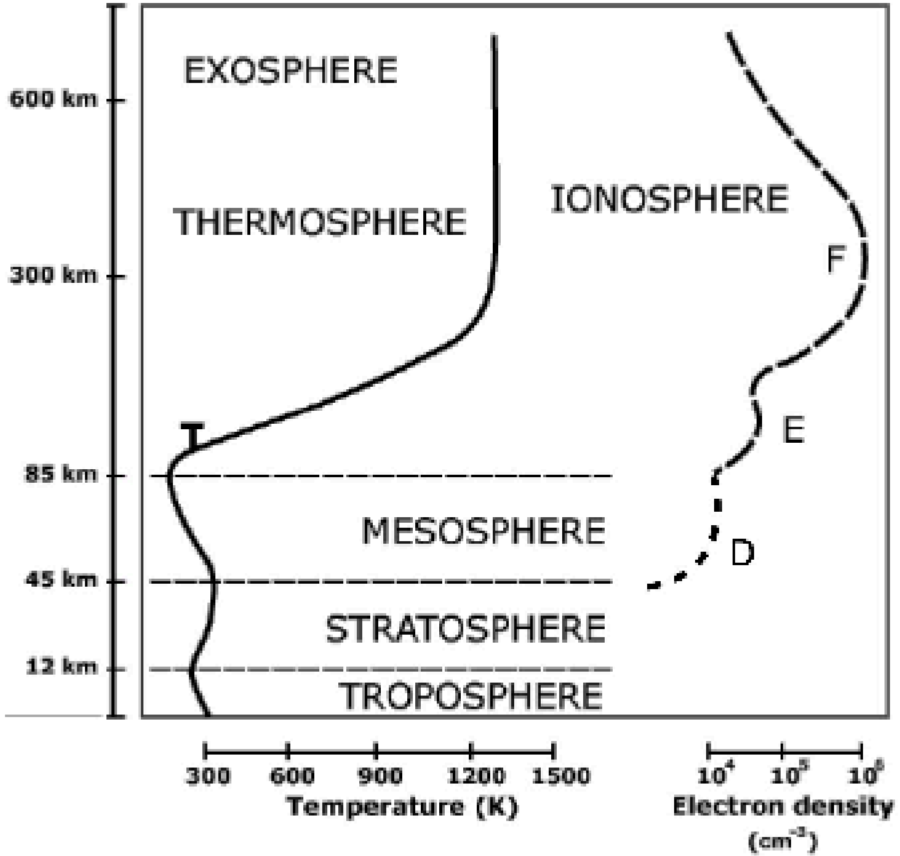


Illustration from the ICON mission, T. Immel et al.

Because the thermosphere/ionosphere system responds to variability from the Earth's lower atmosphere as well as solar-driven "space weather".

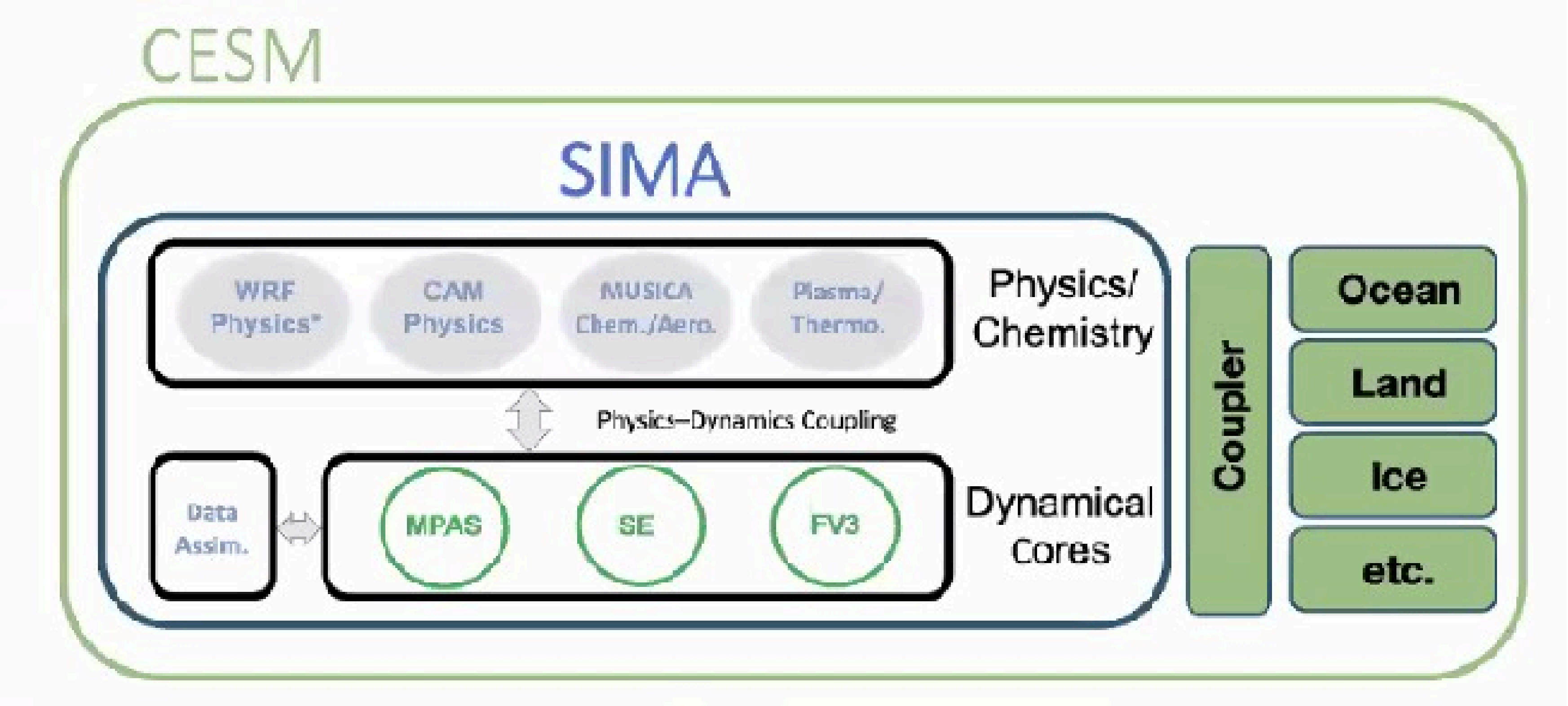
Whole Atmosphere models at NCAR





Motivation

System for Integrated Modeling of the Atmosphere (SIMA)



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

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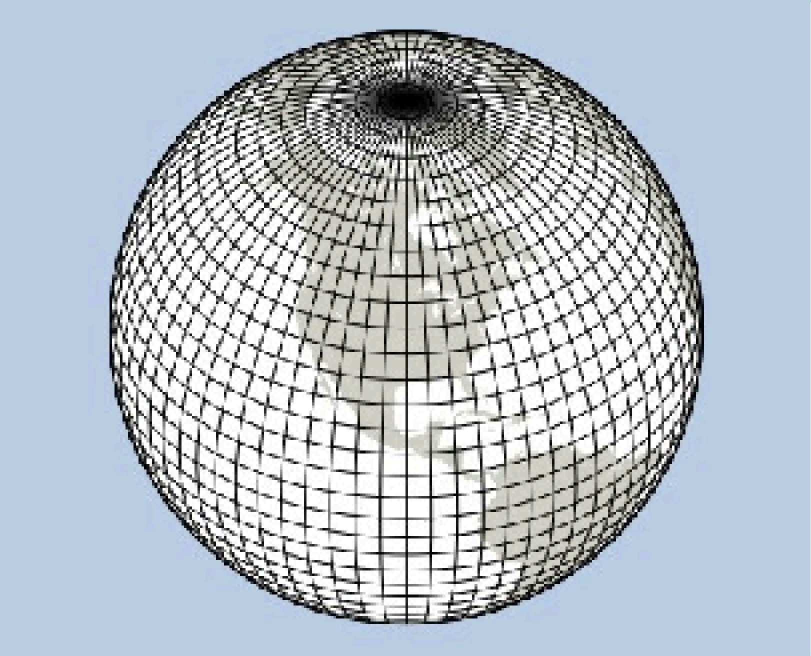
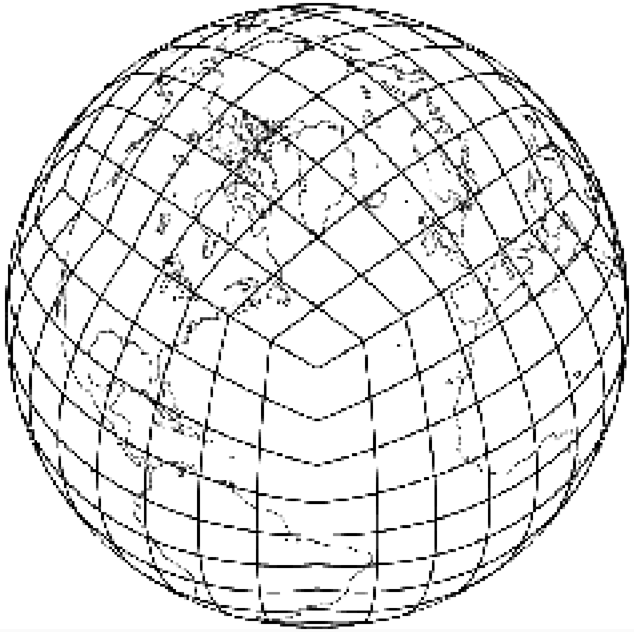
Dynamical Cores Used with WACCM

Finite Volume (FV)



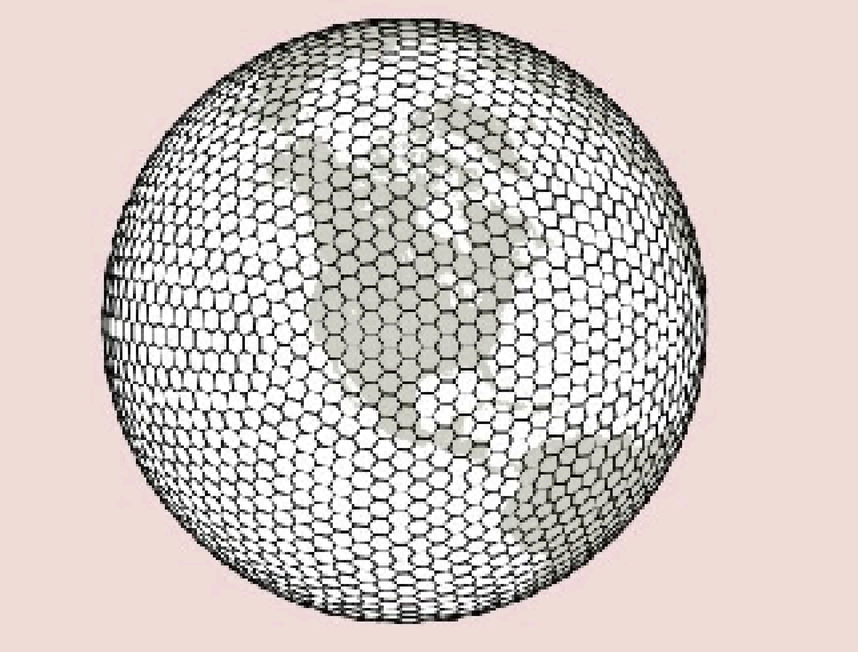
- Lat-Lon global grid, hydrostatic
- Finite-volume, D-grid staggering
- Sigma-pressure vertical coordinate

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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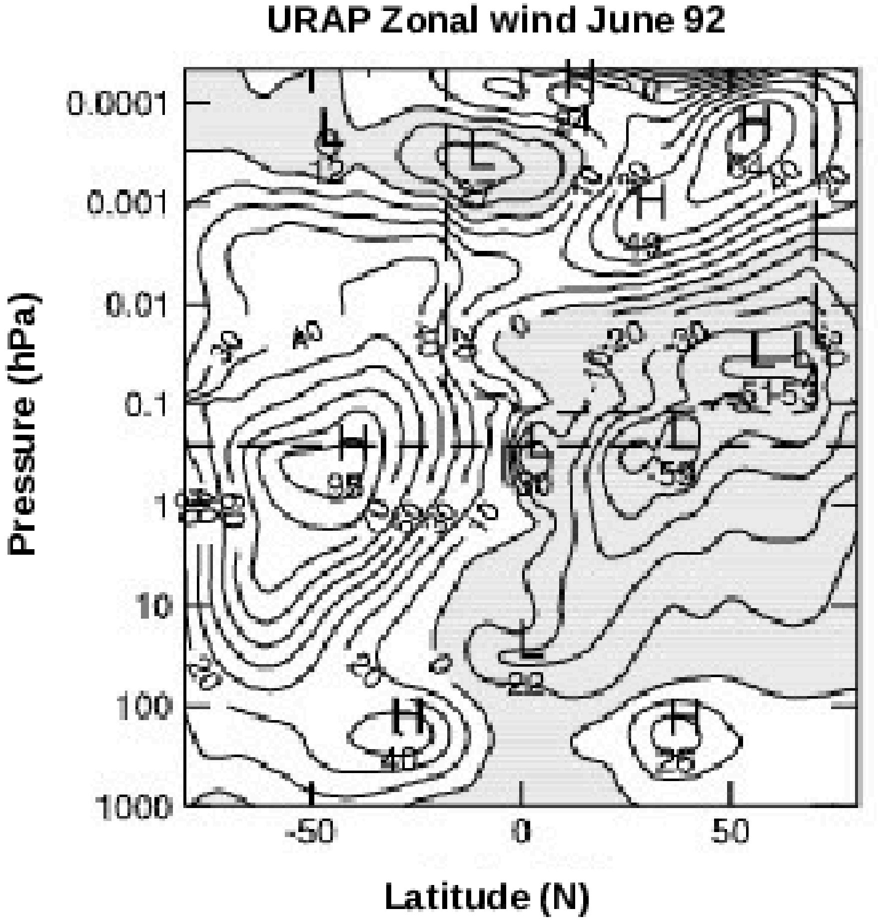
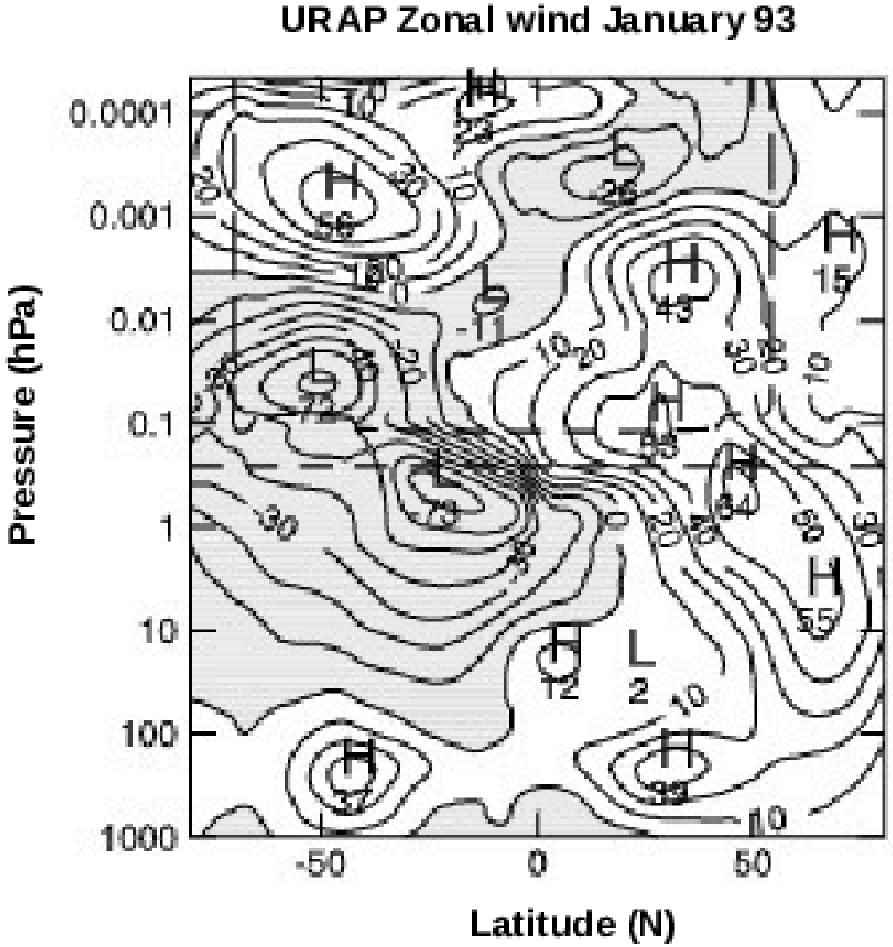
URAP Climatology

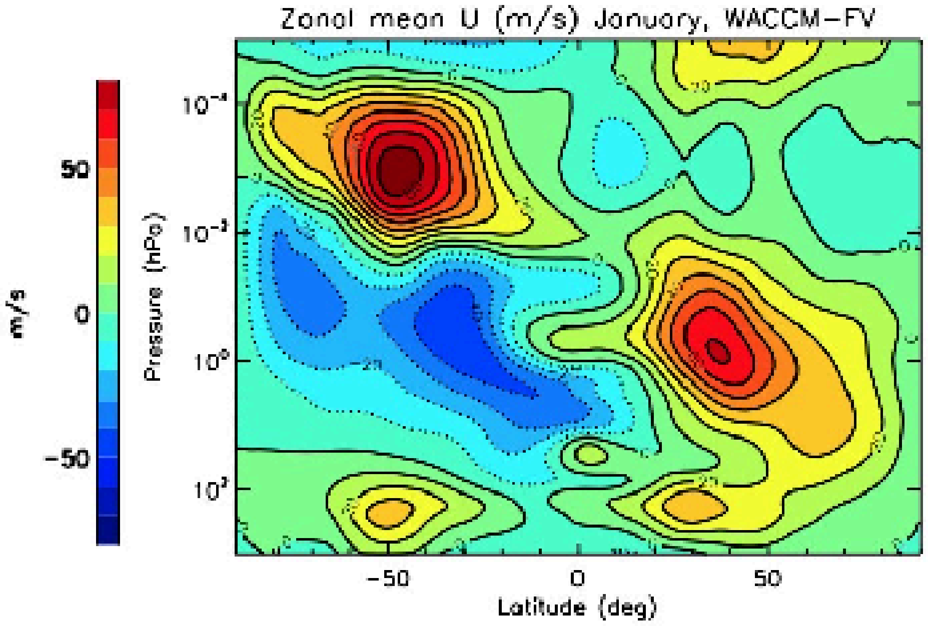




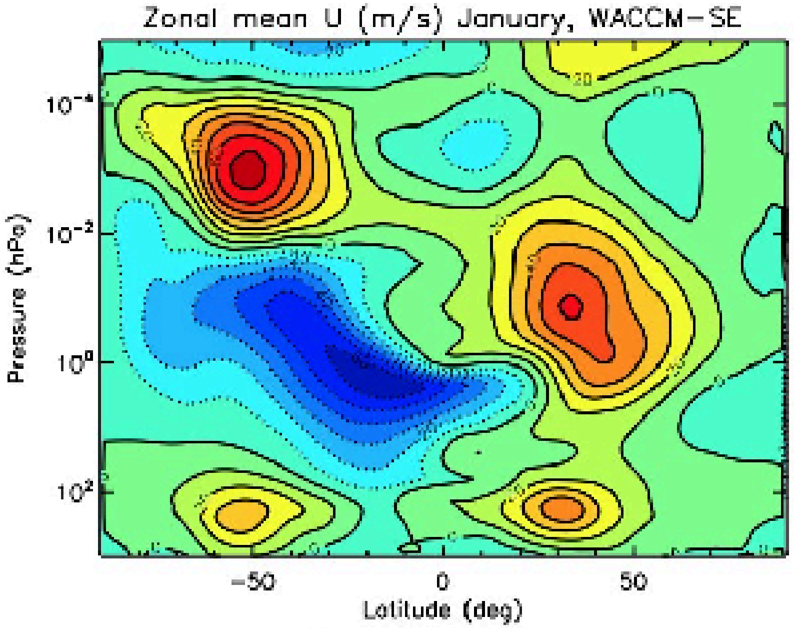
Swinbank and Ortland, 2003

Zonal Mean Wind Climatology Comparison - January

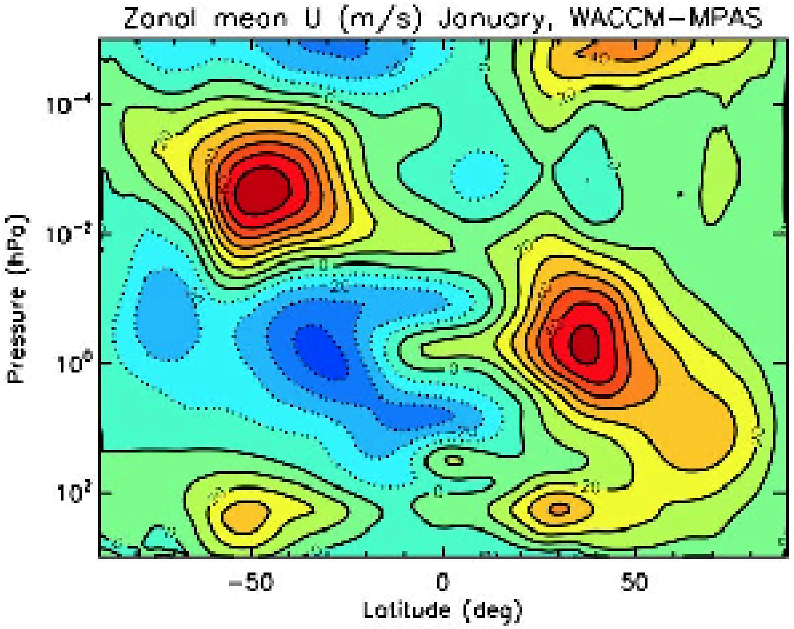
Finite Volume (FV)

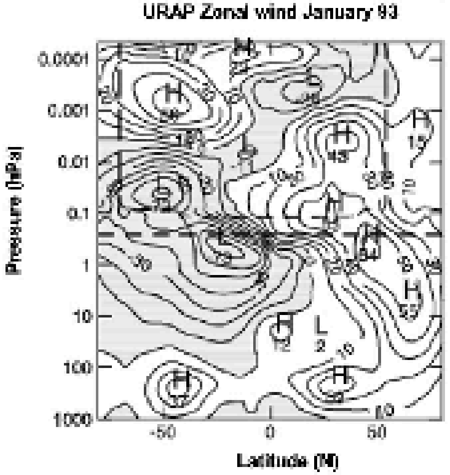


Spectral Element (SE)



MPAS-A

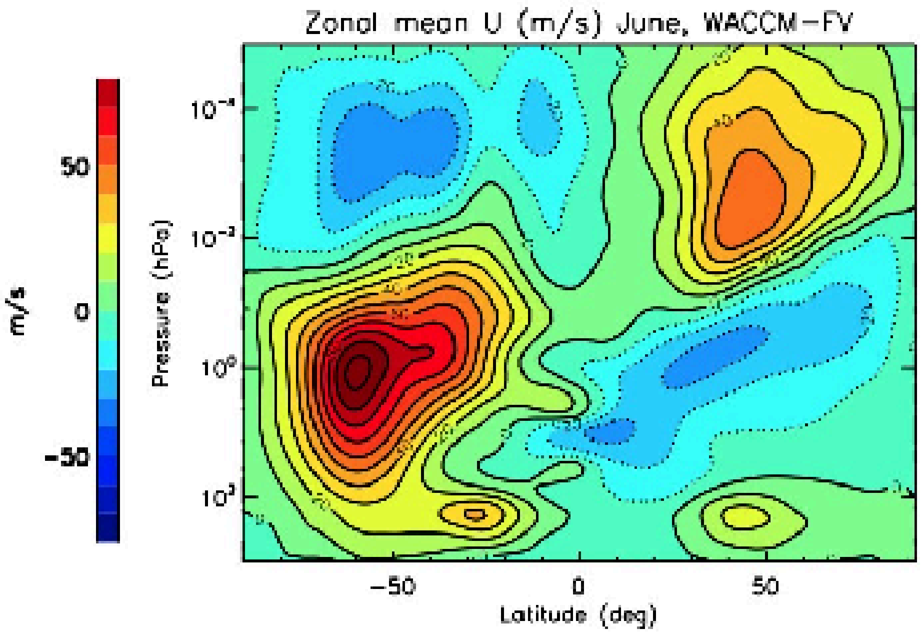




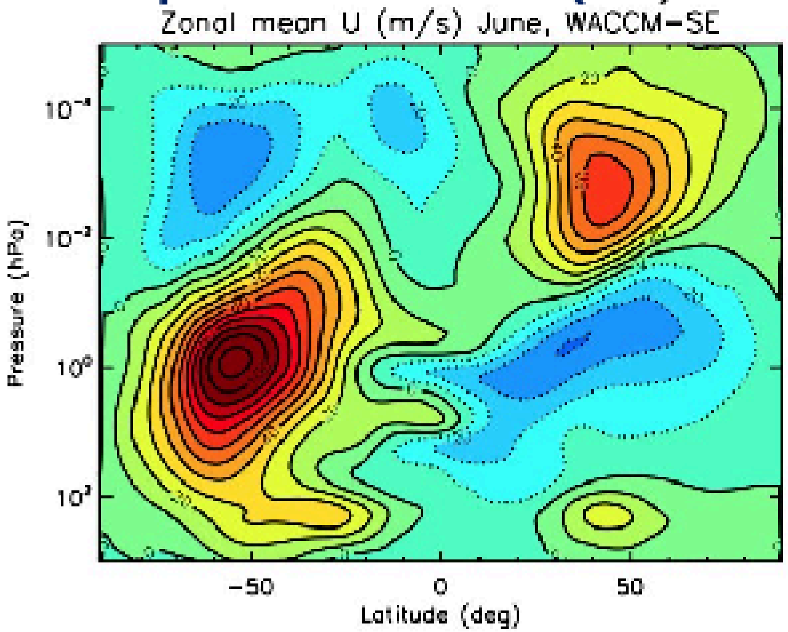
Swinbank and Ortland, 2003

Zonal Mean Wind Climatology Comparison- June

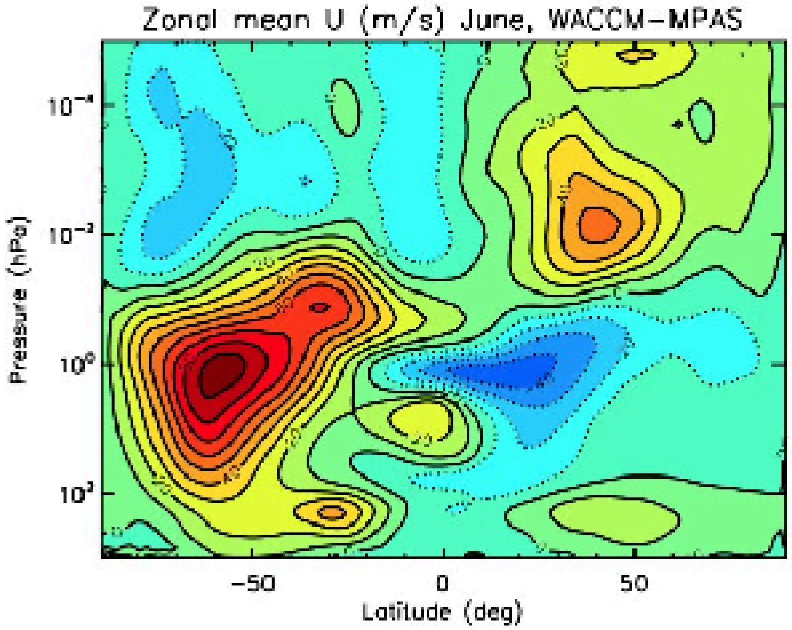
Finite Volume (FV)

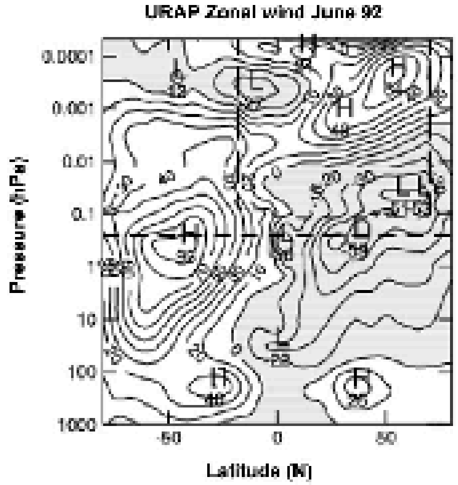


Spectral Element (SE)



MPAS-A





Swinbank and Ortland, 2003

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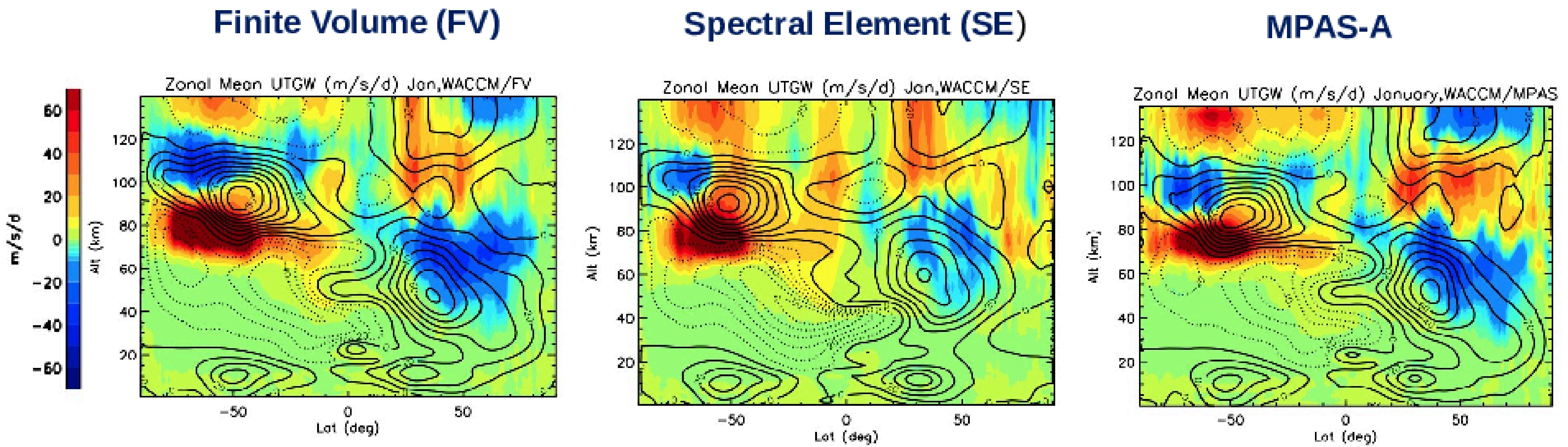
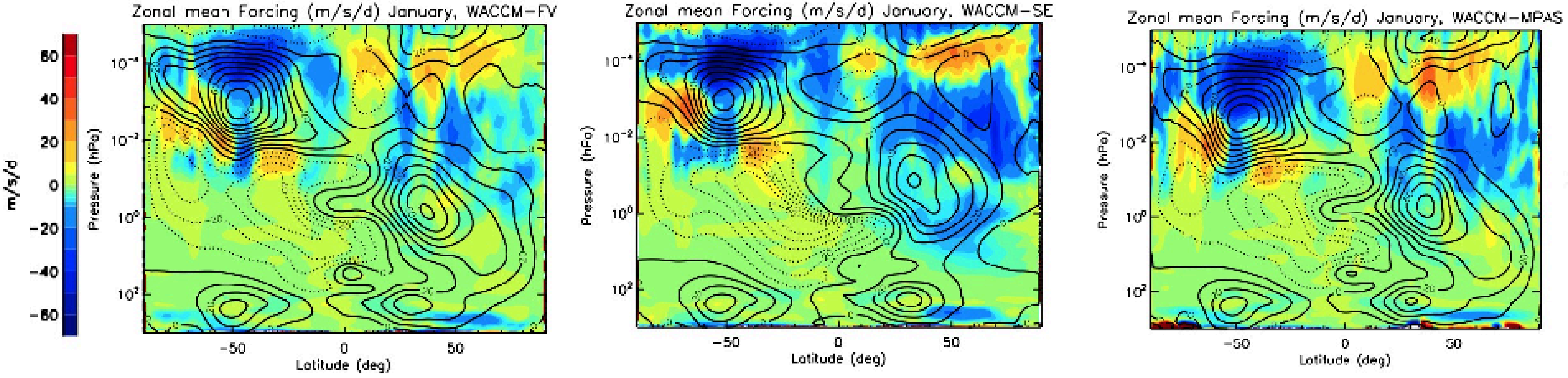
Parametrized Wave Forcing - January



Resolved Wave Forcing - January

Finite Volume (FV) | **Spectral Element (SE)** | **MPAS-A**



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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.
- Perform high resolution simulations at convective scales.
- Adapt the non-hydrostatic MPAS-A to work with WACCM-X.

THANK YOU!!

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NCAR

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