MPAS
Model for Prediction Across Scales

Mountain Wave Test Case – 2D flow(*x*,*z*)

MPAS
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MPAS Atmosphere 6.1 was released on 11 May 2018.

Any questions related to building and running MPAS-Atmosphere should be directed to the MPAS-Atmosphere Help forum. Posting to the forum requires a free google account. Alternatively, questions may be sent from any e-mail address to "mpas-atmosphere-help **AT** googlegroups.com". *Please note that in either case, questions and their answers will appear on the online forum.*

MPAS Atmosphere 6.0 release notes
MPAS source code download
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MPAS-Atmosphere meshes
Configurations for idealized test cases
Sample input files for real-data simulations
Visualization and analysis tools

A variable resolution MPAS Voronoi mesh

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Test cases on the Cartesian plane

Supercell

Download

Mountain-wave

Download

Test cases on the sphere

Jablonowski and Williamson baroclinic wave

Download

mountain_wave.tar

mountain_wave/
mountain_wave/mtn_wave_w.ncl
mountain_wave/README
mountain_wave/stream_list.atmosphere.output
mountain_wave/namelist.init_atmosphere
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mountain_wave/streams.atmosphere
mountain_wave/streams.init_atmosphere
mountain_wave/namelist.atmosphere

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Build the MPAS initialization program and the MPAS model

MPAS-Model (Version 7, or wherever your MPAS code is located):

The MPAS initialization executable
Edit the Makfile as directed in the README file.
>make clean CORE=init_atmosphere
>make ifort CORE=init_atmosphere (other options here, e.g. PRECISION=single USE_PIO2=true etc.)
This will produce the executable *init_atmosphere_model*

The MPAS model executable
>make clean CORE=atmosphere
>make ifort CORE=atmosphere (other options here, e.g. PRECISION=single USE_PIO2=true etc.)
This will produce the executable *atmosphere_model*

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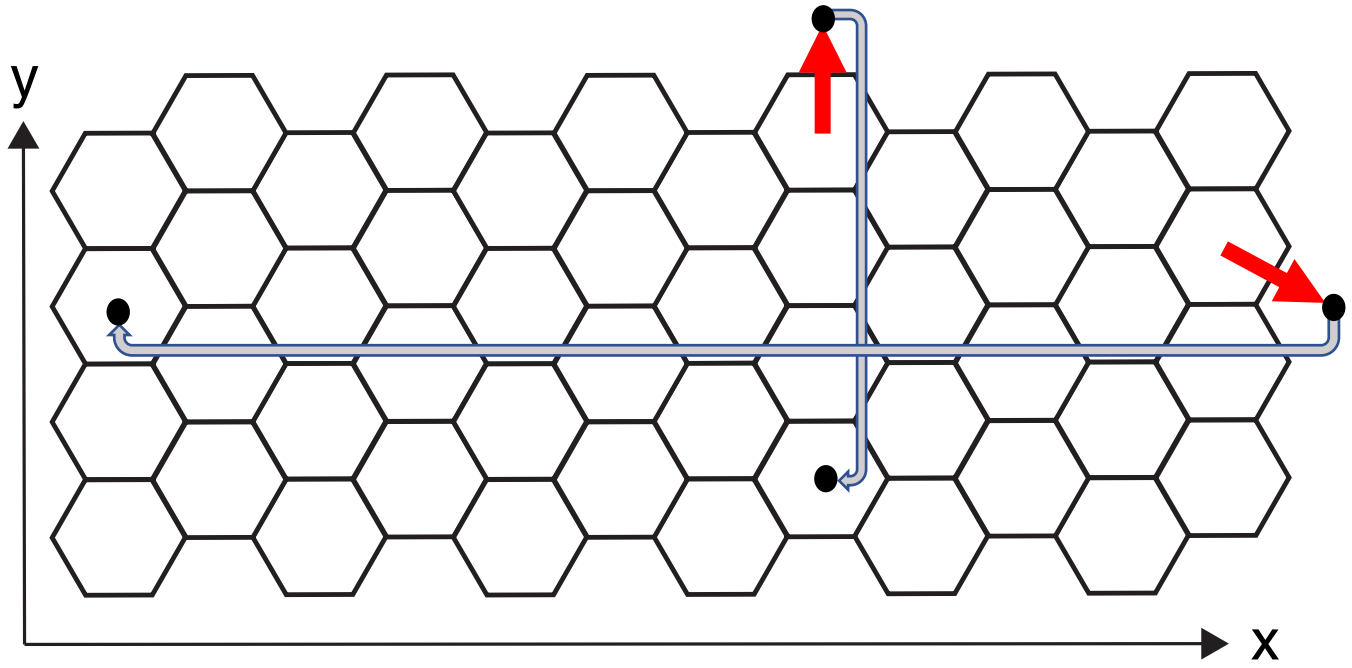
Periodic in *x* and *y*



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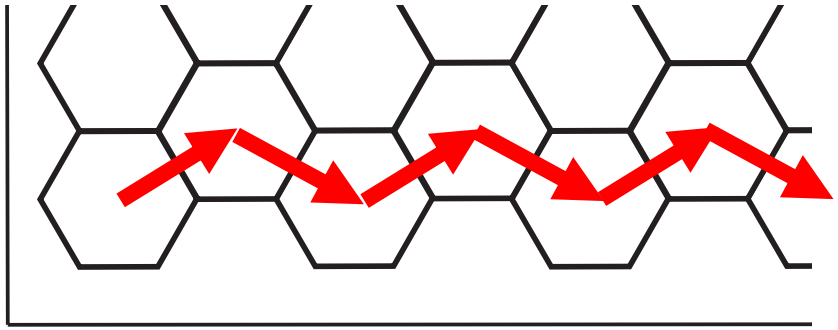
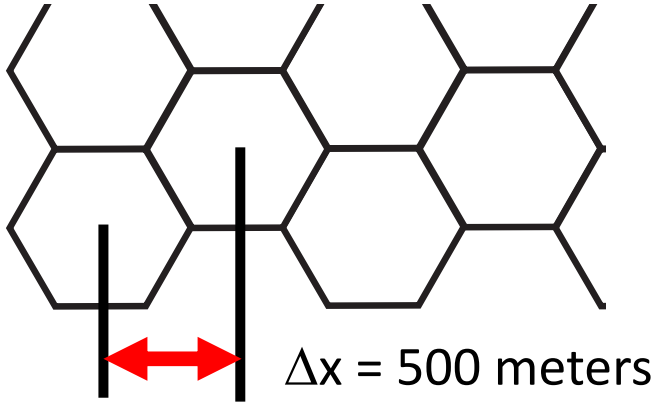
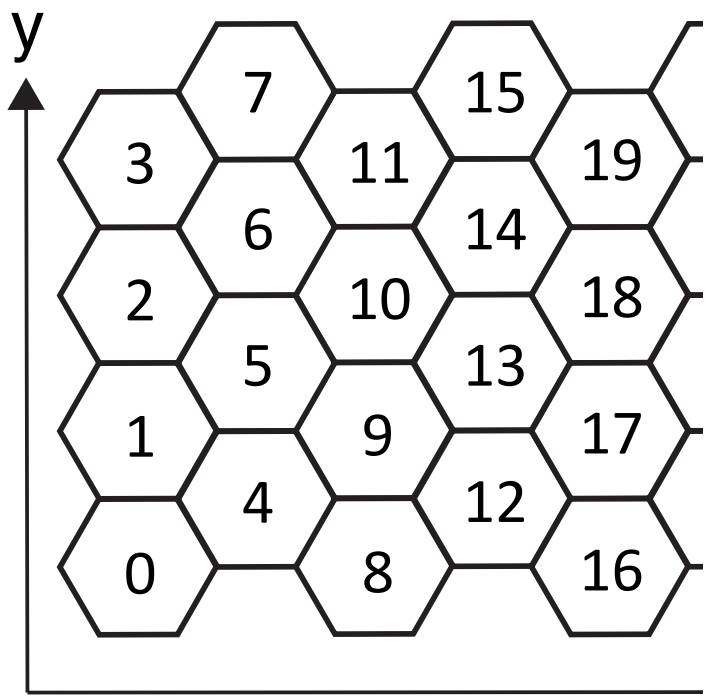
Mountain Wave Test Case – 2D flow(*x*,*z*)

400 cells in *x* direction







cell order in mtn_wave_grid.nc

Note: the MPAS solver doesn't know about or make use of this structure

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Mountain Wave Test Case – 2D flow(*x*,*z*)

namelist.init_atmosphere

```
&nhyd_model
  config_start_time = '0000-01-01_00:00:00'
  config_init_case = 6
  config_theta_adv_order = 3
/

&dimensions
  config_nvertlevels = 70
/
```

In the initialization program
MPAS-Model/src/core_init_atmosphere/
mpas_init_atm_cases.F:

model top = 21000 meters
no stretching, dz = 300 meters

h(x) = H * exp[(x-xc)/xa] * cos[pi * (x-xc)/xb] ** 2
H = 250 meters, N = 0.01/s, U = 10 m/s
Schar (MWR 2000), Klemp et al (MWR 2003) test case

streams.init_atmosphere

```
<streams>
<immutable_stream name="input"
          type="input"
          filename_template="mtn_wave_grid.nc"
          input_interval="initial_only" />

<immutable_stream name="output"
          type="output"
          filename_template="mtn_wave_init.nc"
          packages="initial_conds"
          output_interval="initial_only" />

<immutable_stream name="surface"
          type="output"
          filename_template="not_needed_for_mtn_wave"
          filename_interval="none"
          packages="sfc_update"
          output_interval="86400" />

</streams>
```

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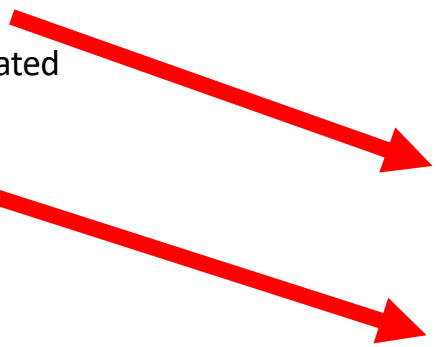
Mountain Wave Test Case – 2D flow(*x*,*z*)

Run *init_atmosphere_model*
mtn_wave_init.nc will be created

Run *atmosphere_model*

output.nc will be created
output every 30 minutes
5 hour simulation
no restart file
no other output files



mountain_wave/
mountain_wave/mtn_wave_w.ncl
mountain_wave/README
mountain_wave/namelist.init_atmosphere
mountain_wave/streams.init_atmosphere
mountain_wave/mtn_wave_grid.nc
mountain_wave/streams.atmosphere
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mountain_wave/namelist.atmosphere
mtn_wave_init.nc

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mountain_wave/streams.atmosphere

streams.atmosphere is where the input and output files are set: names, I/O types, I/O intervals, etc.

```
<streams>

<immutable_stream name="input"
                  type="input"
                  filename_template="mtn_wave_init.nc"
                  input_interval="initial_only"/>

<immutable_stream name="restart"
                  type="input;output"
                  filename_template="restart.$Y-$M-$D_$h.$m.$s.nc"
                  input_interval="initial_only"
                  output_interval="1_00:00:00"/>

<stream name="output"
        type="output"
        filename_template="output.nc"
        filename_interval="none"
        output_interval="00:30:00">

    <file name="stream_list.atmosphere.output"/>

</stream>

</streams>
```

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Mountain Wave Test Case – 2D flow(*x*,*z*)

mountain_wave/namelist.atmosphere 

namelist.atmosphere is where the integration parameters are set: start time, integration time, restart or init, physics, etc.

```
&nhyd_model
   config_dt = 6.0
   config_start_time = '0000-01-01_00:00:00'
   config_run_duration = '05:00:00'
   config_split_dynamics_transport = false
   config_number_of_sub_steps = 6
   config_dynamics_split_steps = 1
   config_h_mom_eddy_visc2   = 10.0
   config_h_mom_eddy_visc4   = 0.0
   config_v_mom_eddy_visc2   = 10.0
   config_h_theta_eddy_visc2 = 10.0
   config_h_theta_eddy_visc4 = 0.0
   config_v_theta_eddy_visc2 = 10.0
   config_horiz_mixing = '2d_fixed'
   config_len_disp = 577.35
   config_theta_adv_order  = 3
   config_w_adv_order      = 3
   config_u_vadv_order     = 3
   config_w_vadv_order     = 3
   config_theta_vadv_order = 3
   config_coef_3rd_order = 0.25
   config_scalar_advection = false
   config_epssm = 0.1
   config_smdiv = 0.1
   config_h_ScaleWithMesh = false
/
```

```
&damping
   config_zd = 10500.0
   config_xnutr = 0.1
/


&restart
   config_do_restart = false
/


&printout
   config_print_global_minmax_vel = true
/


&physics
   config_sst_update = false
   config_sstdiurn_update = false
   config_deepsoiltemp_update = false
   config_radtlw_interval = '00:30:00'
   config_radtsw_interval = '00:30:00'
   config_bucket_update = 'none'
   config_physics_suite = 'none'
```

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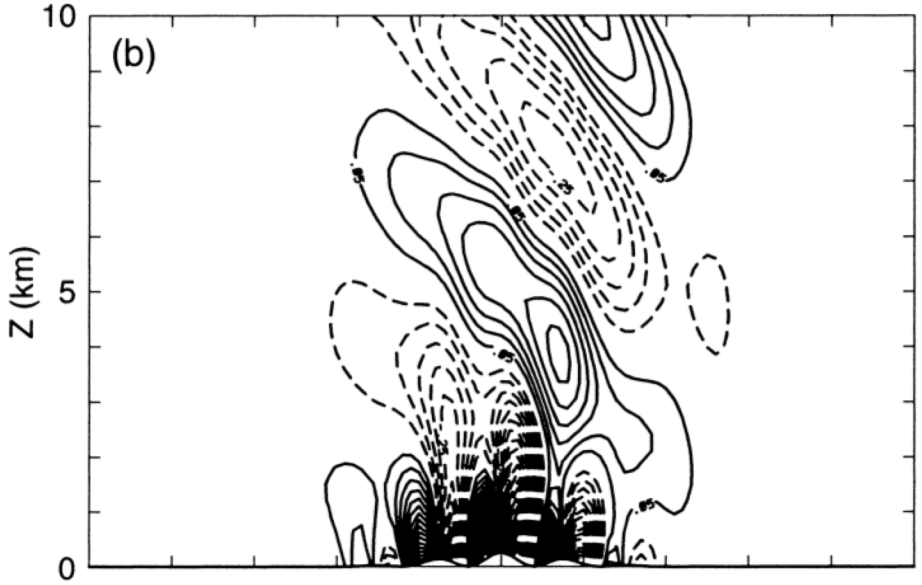
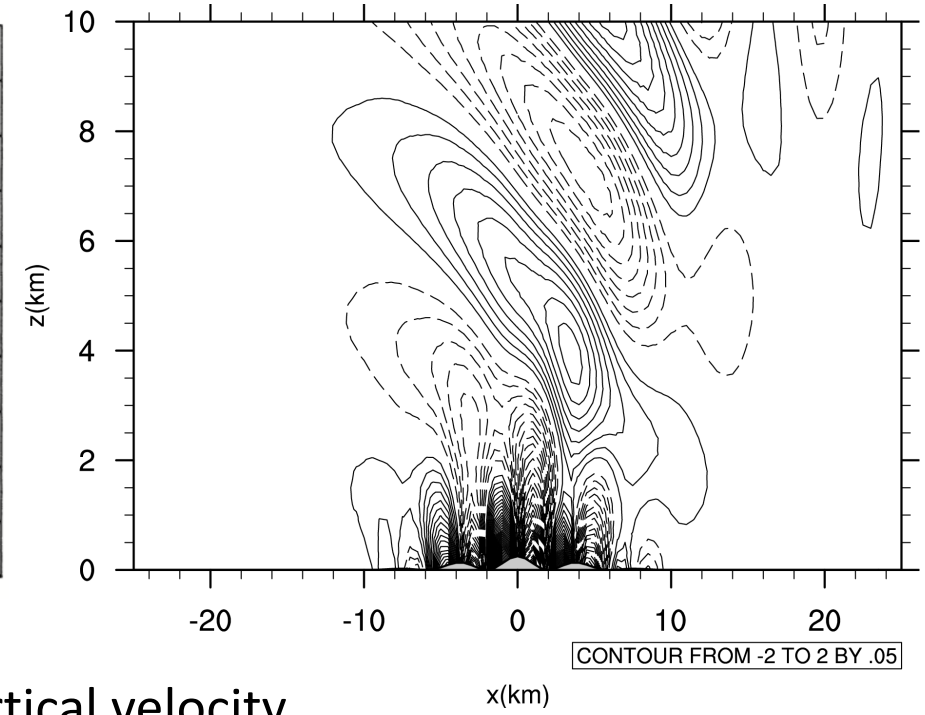
Analytic solution



MPAS at T = 5h



Vertical velocity

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3D Supercell Test Case

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Supercell

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Mountain-wave

Download

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Jablonowski and Williamson baroclinic wave

Download

supercell.tar

supercell/README
supercell/namelist.atmosphere
supercell/stream_list.atmosphere.output
supercell/namelist.init_atmosphere
supercell/supercell.ncl
supercell/streams.atmosphere
supercell/supercell_grid.nc
supercell/streams.init_atmosphere
supercell/LANDUSE.TBL
supercell/supercell.graph.info.part.2
supercell/supercell.graph.info.part.4
supercell/supercell.graph.info.part.8
supercell/supercell.graph.info.part.12
supercell/supercell.graph.info.part.16
supercell/supercell.graph.info.part.24
supercell/supercell.graph.info.part.32

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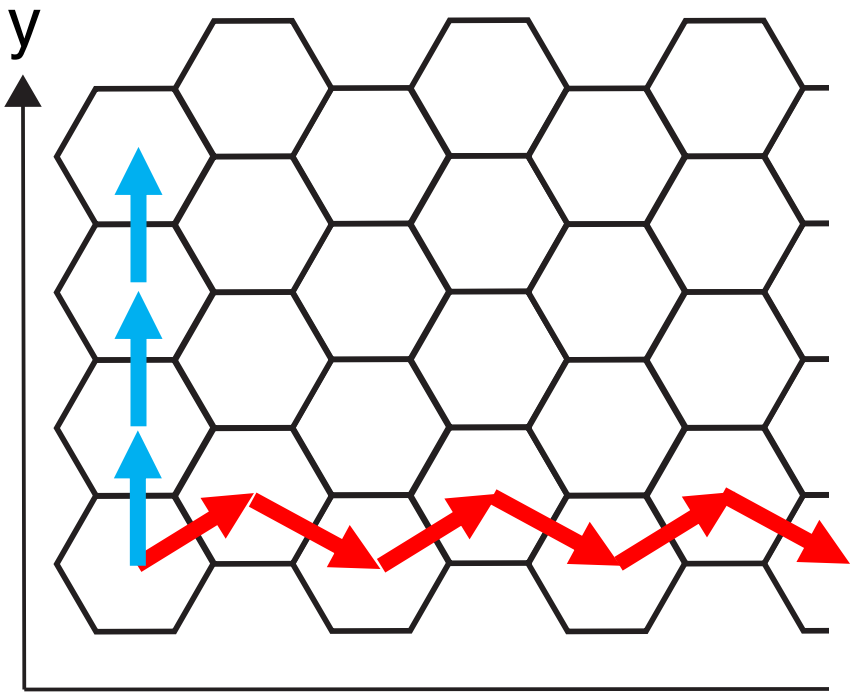
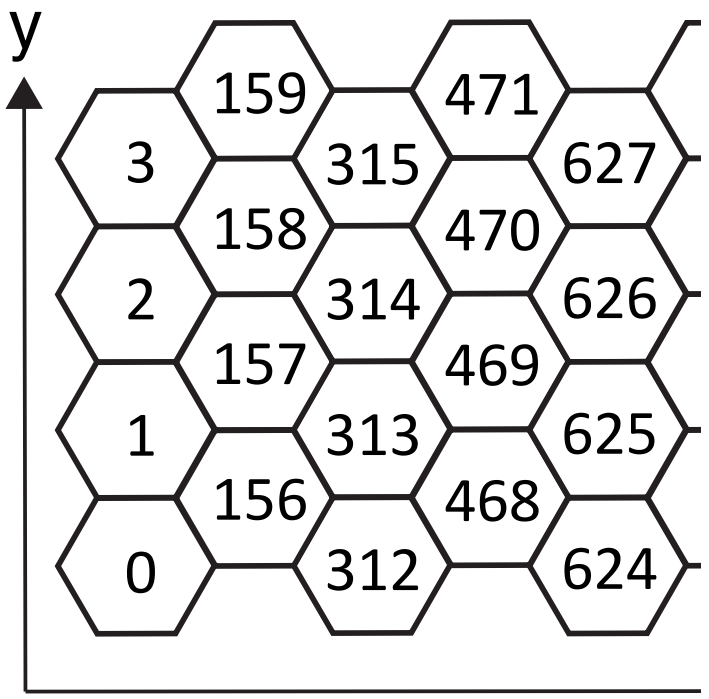
Model for Prediction Across Scales

3D Supercell Test Case



156 cells in *y* direction
180 cells in *x* direction
approximately 84x84 km domain



cell order in supercell_grid.nc

Note: the MPAS solver doesn't know about or make use of this structure

MPAS
Model for Prediction Across Scales

3D Supercell Test Case

supercell/
namelist.atmosphere

```
&nhyd_model
   config_dt = 3.0
   config_start_time = '0000-01-01_00:00:00'
   config_run_duration = '02:00:00'
   config_split_dynamics_transport = false
   config_number_of_sub_steps = 6
   config_dynamics_split_steps = 1
   config_h_mom_eddy_visc2  = 500.0
   config_h_mom_eddy_visc4  = 0.0
   config_v_mom_eddy_visc2  = 500.0
   config_h_theta_eddy_visc2 = 500.0
   config_h_theta_eddy_visc4 = 0.0
   config_v_theta_eddy_visc2 = 500.0
   config_horiz_mixing = '2d_fixed'
   config_len_disp = 538.86
   config_theta_adv_order  = 3
   config_w_adv_order      = 3
   config_u_vadv_order     = 3
   config_w_vadv_order     = 3
   config_theta_vadv_order = 3
   config_coef_3rd_order = 0.25
   config_epssm = 0.1
   config_smdiv = 0.1
   config_mix_full = false
   config_monotonic = true
   config_h_ScaleWithMesh = false
/
```

```
&damping
   config_zd = 20000.0
   config_xnutr = 0.0
/
&io
/
&decomposition
   config_block_decomp_file_prefix = 'supercell.graph.info.part.'
/
&restart
   config_do_restart = false
/
&printout
   config_print_global_minmax_vel = true
   config_print_global_minmax_sca = true
/
&physics
   config_sst_update = false
   config_sstdiurn_update = false
   config_deepsoiltemp_update = false
   config_radtlw_interval = '00:30:00'
   config_radtsw_interval = '00:30:00'
   config_bucket_update = 'none'
   config_physics_suite = 'none'
   config_microp_scheme = 'mp_kessler'
/
```

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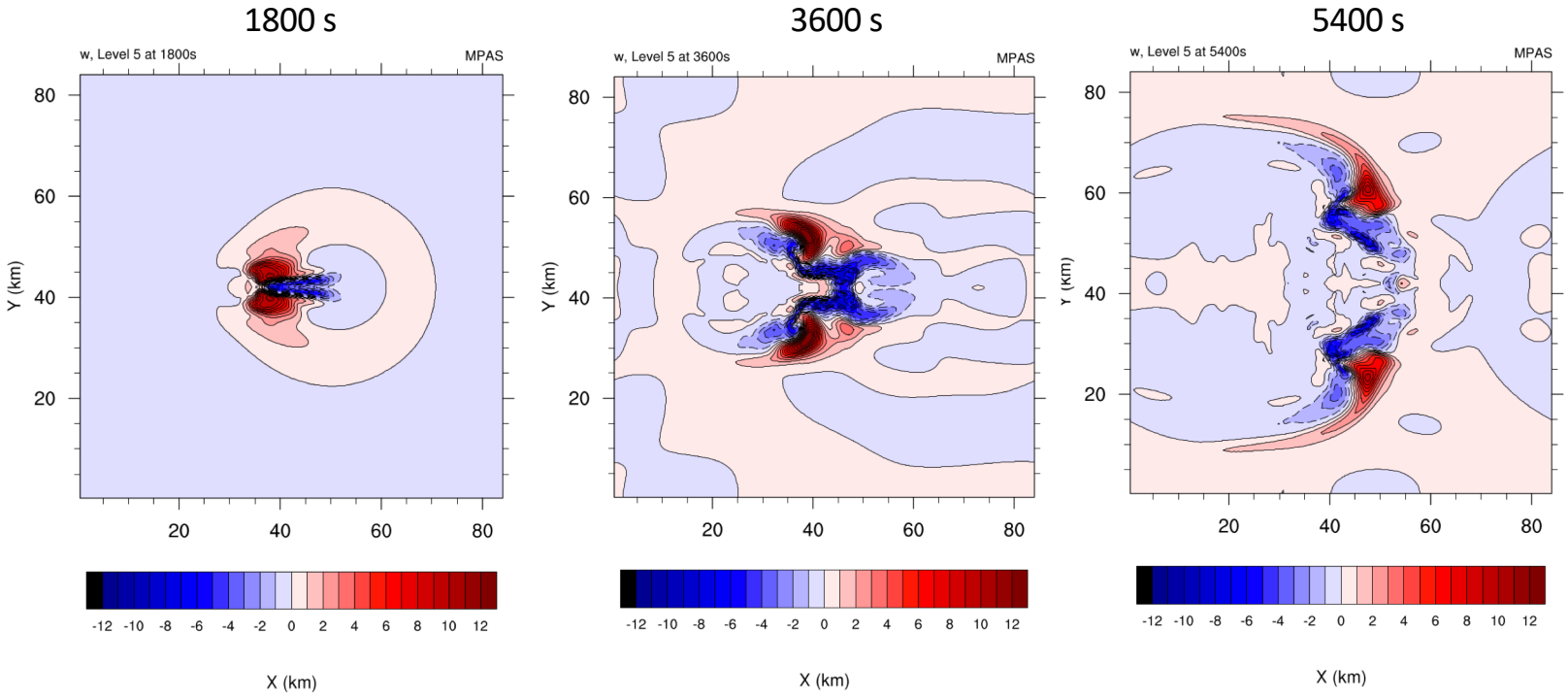
3D Supercell Test Case

Vertical velocity (w, m/s) at 2 km



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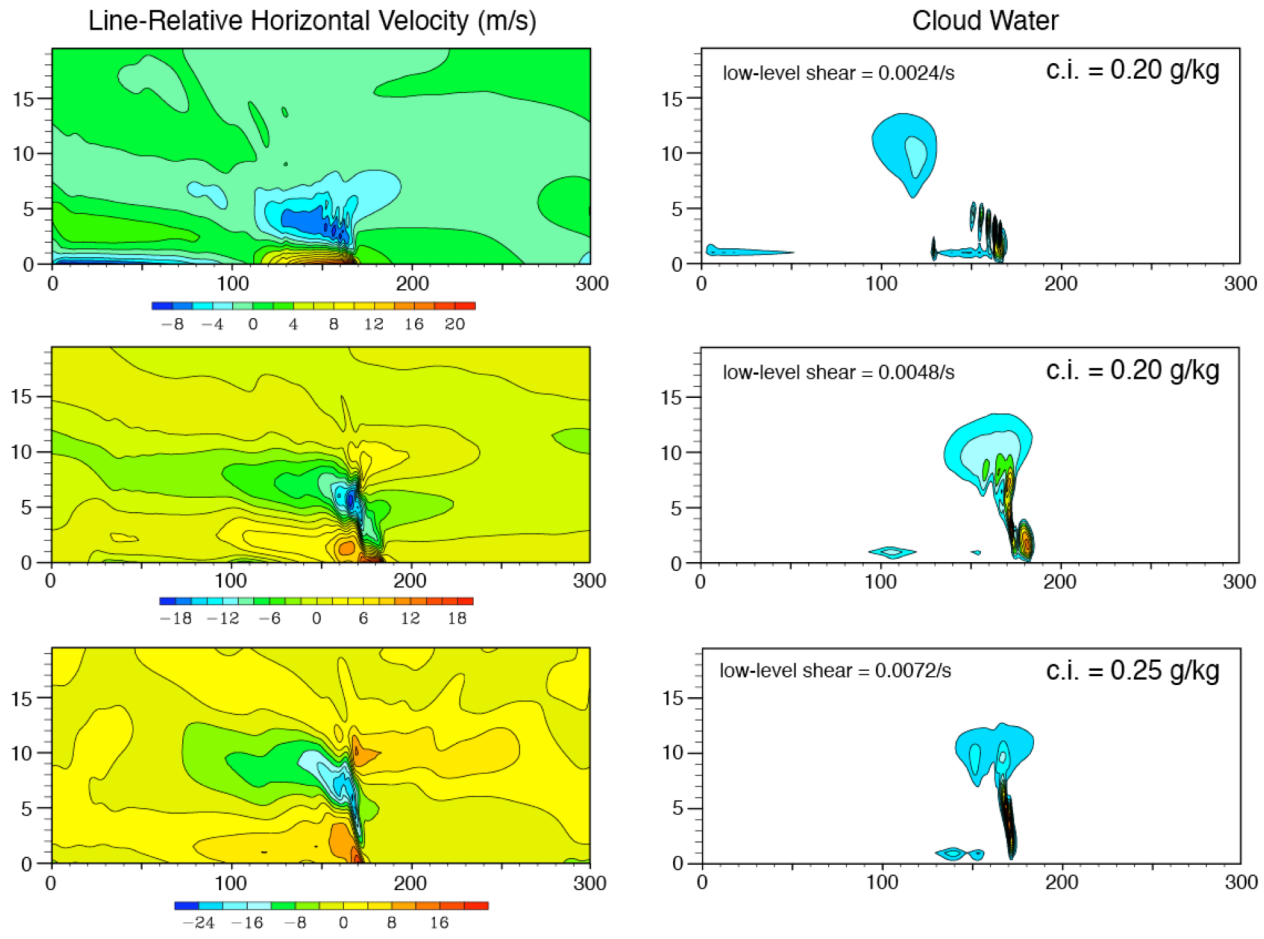
Squall-line test case

Note: not part of the MPAS release

Low-level shear (0-2.5 km), Weisman-Klemp sounding
Warm-bubble perturbation, results at 3 hours



(from Max Menchaca)

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Baroclinic wave test case

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Jablonowski and Williamson baroclinic wave

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Baroclinic waves on the sphere
120 km (~ 1 deg) global mesh

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jw_baroclinic_wave/
jw_baroclinic_wave/README
jw_baroclinic_wave/namelist.atmosphere
jw_baroclinic_wave/namelist.init_atmosphere
jw_baroclinic_wave/x1.40962.grid.nc
jw_baroclinic_wave/bwave_surface_p.ncl
jw_baroclinic_wave/streams.init_atmosphere
jw_baroclinic_wave/streams.atmosphere
jw_baroclinic_wave/stream_list.atmosphere.output
jw_baroclinic_wave/x1.40962.graph.info.part.2
jw_baroclinic_wave/x1.40962.graph.info.part.4
jw_baroclinic_wave/x1.40962.graph.info.part.6
jw_baroclinic_wave/x1.40962.graph.info.part.8
jw_baroclinic_wave/x1.40962.graph.info.part.12
jw_baroclinic_wave/x1.40962.graph.info.part.16
jw_baroclinic_wave/x1.40962.graph.info.part.24

Jablonowski and Williamson (2006) baroclinic wave test case

MPAS
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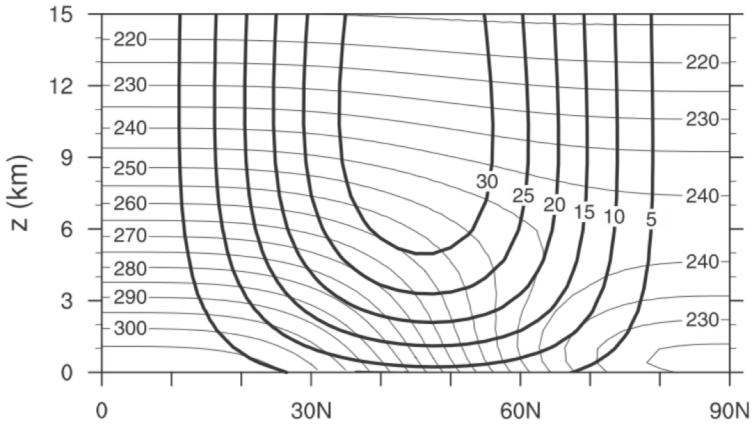
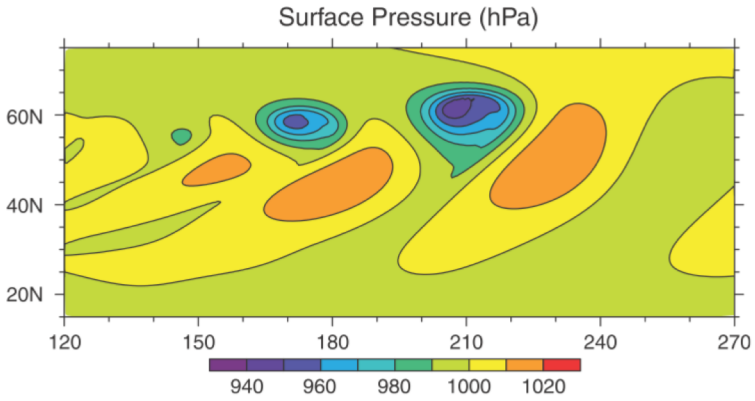
Baroclinic wave test case



Initial jet (U, m/s; theta, K)



Surface pressure at day 9