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

MPAS
Model for Prediction Across Scales

MPAS Atmosphere Public Releases

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MPAS-Albany Land Ice
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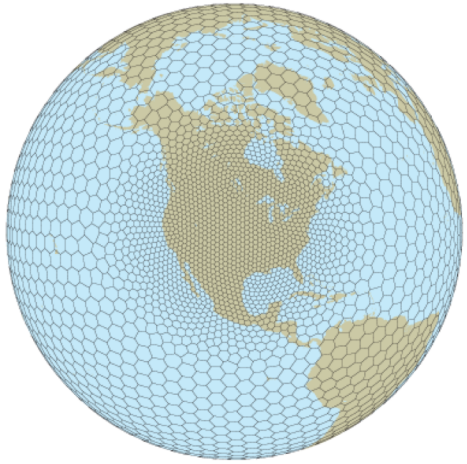
MPAS Developers Guide
MPAS Mesh Specification Document

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
MPAS-Atmosphere Users' Guide
MPAS-Atmosphere tutorial presentations
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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MPAS-Atmosphere Idealized Test Cases

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- an MPAS mesh file to be used with the test case;
- for 3-d test cases, mesh decomposition files for several MPI task counts;
- a namelist file for creating initial conditions for the test case;
- a namelist file for running the model; and
- NCL scripts for making plots of the output.

The process of generating initial conditions and running each test case is described in further detail in the MPAS-Atmosphere Users' Guide.

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
mountain_wave/mtn_wave_grid.nc
mountain_wave/streams.atmosphere
mountain_wave/streams.init_atmosphere
mountain_wave/namelist.atmosphere

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

Build the MPAS initialization program and the MPAS model

In MPAS-Release-6.1 (or wherever your MPAS code is located):

In the README file, for the mountain wave test case only:

** Running the mountain wave test case requires both the 'init_atmosphere_model'*
** and 'atmosphere_model' executables to be compiled with -DROTATED_GRID added*
** to the specification of MODEL_FORMULATION at the top of MPAS/Makefile.*
***
** Please be sure to clean and compile both executables with the -DROTATED_GRID*
** flag set before running this test case!*

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

Build the MPAS initialization program and the MPAS model

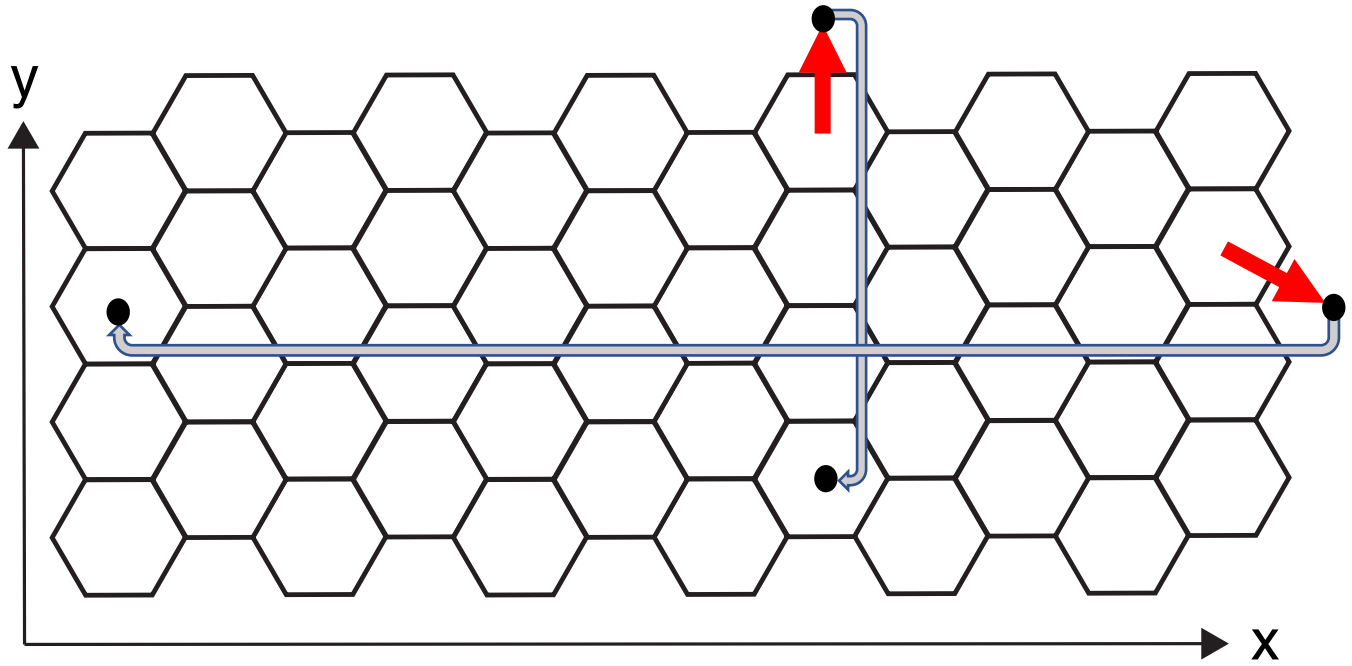
In MPAS-Release-6.1 (or wherever your MPAS code is located):

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*

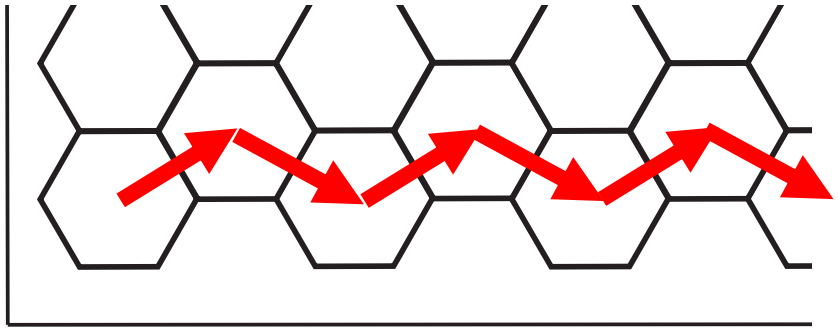
Mountain Wave Test Case – 2D flow(x,z)

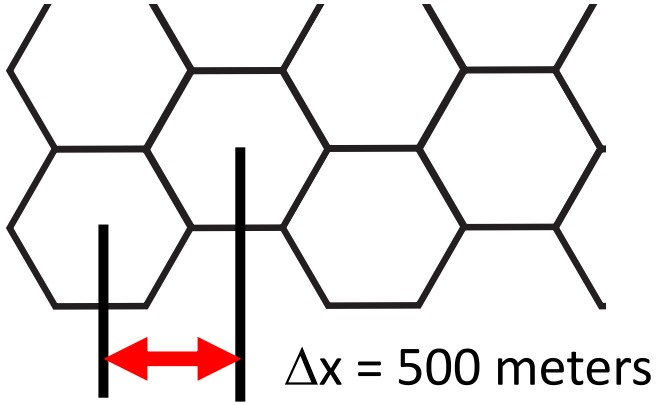
Periodic in x and y

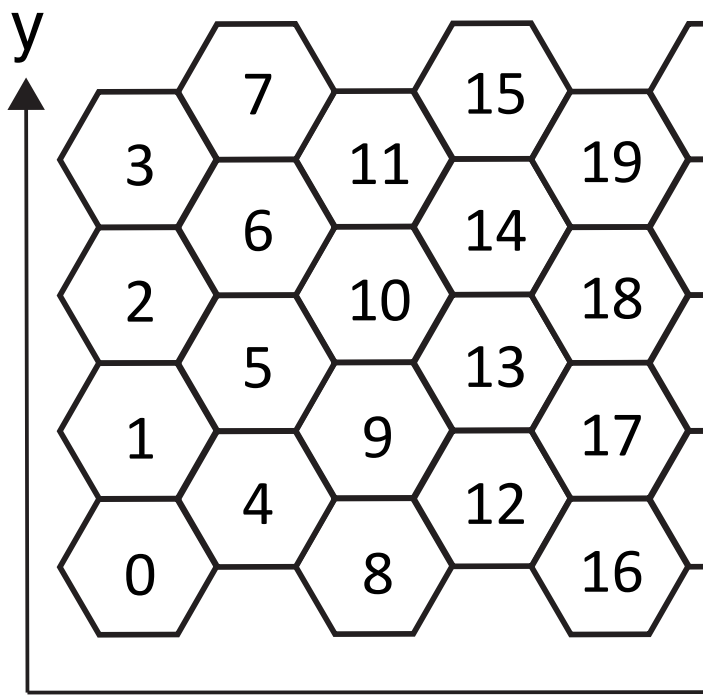


Mountain Wave Test Case

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

Mountain Wave Test Case

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-Release-6.1/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

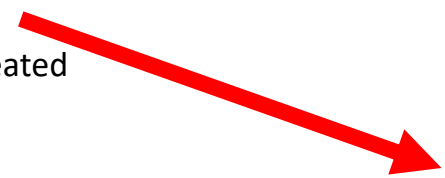
```
<streams>
<immutable_stream name="input"
        type="input"
        filename_template="mtn_wave_grid.nc"
        input_interval="initial_only" />


<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>
```

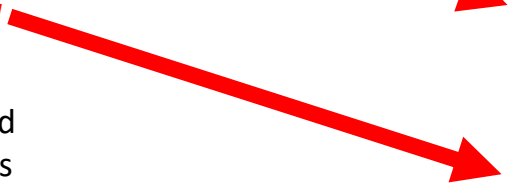
Mountain Wave Test Case

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
mountain_wave/stream_list.atmosphere.output
mountain_wave/namelist.atmosphere

mtn_wave_init.nc

Mountain Wave Test Case

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>
```

Mountain Wave Test Case

mountain_wave/namelist.atmosphere 

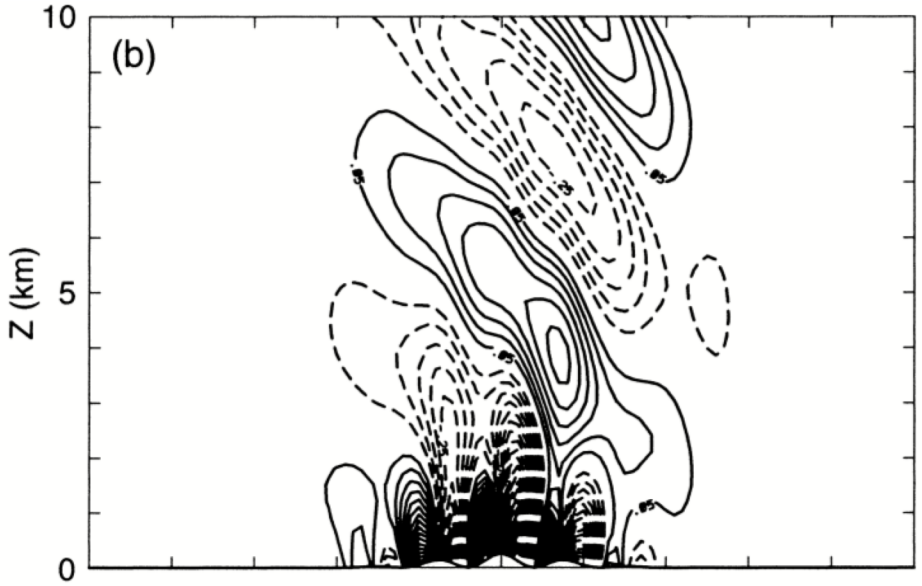
namelist.atmosphere is where the integration parameters are set: start time, integration time, restart or init, physics, etc.

```
&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
/
```

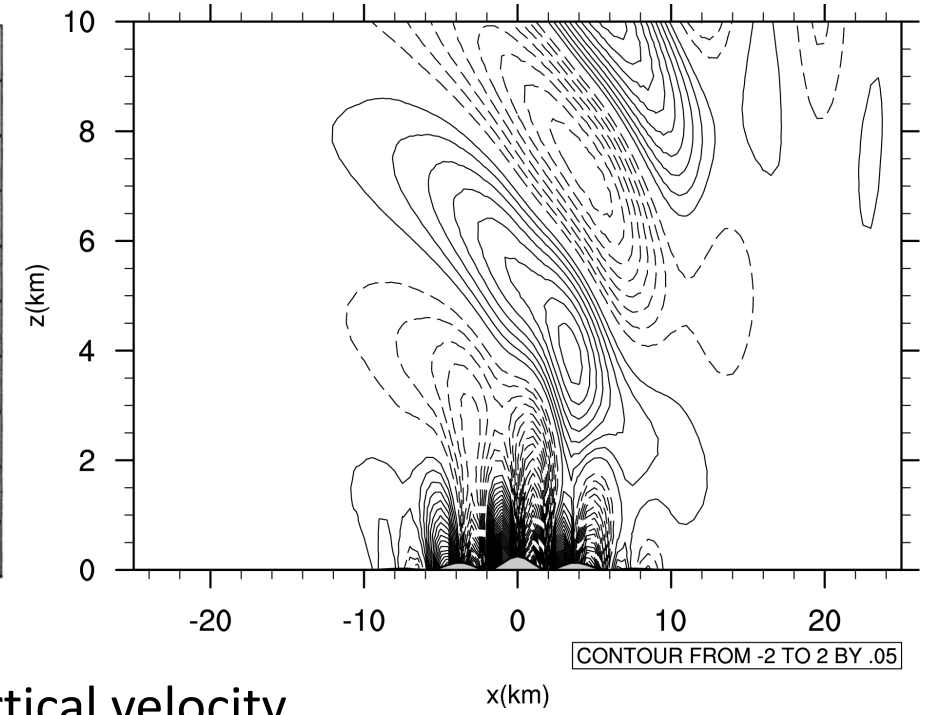
```
&damping
   config_zd = 10500.0
   config_xnutr = 0.1
/


&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'
```

Mountain Wave Test Case

Analytic solution

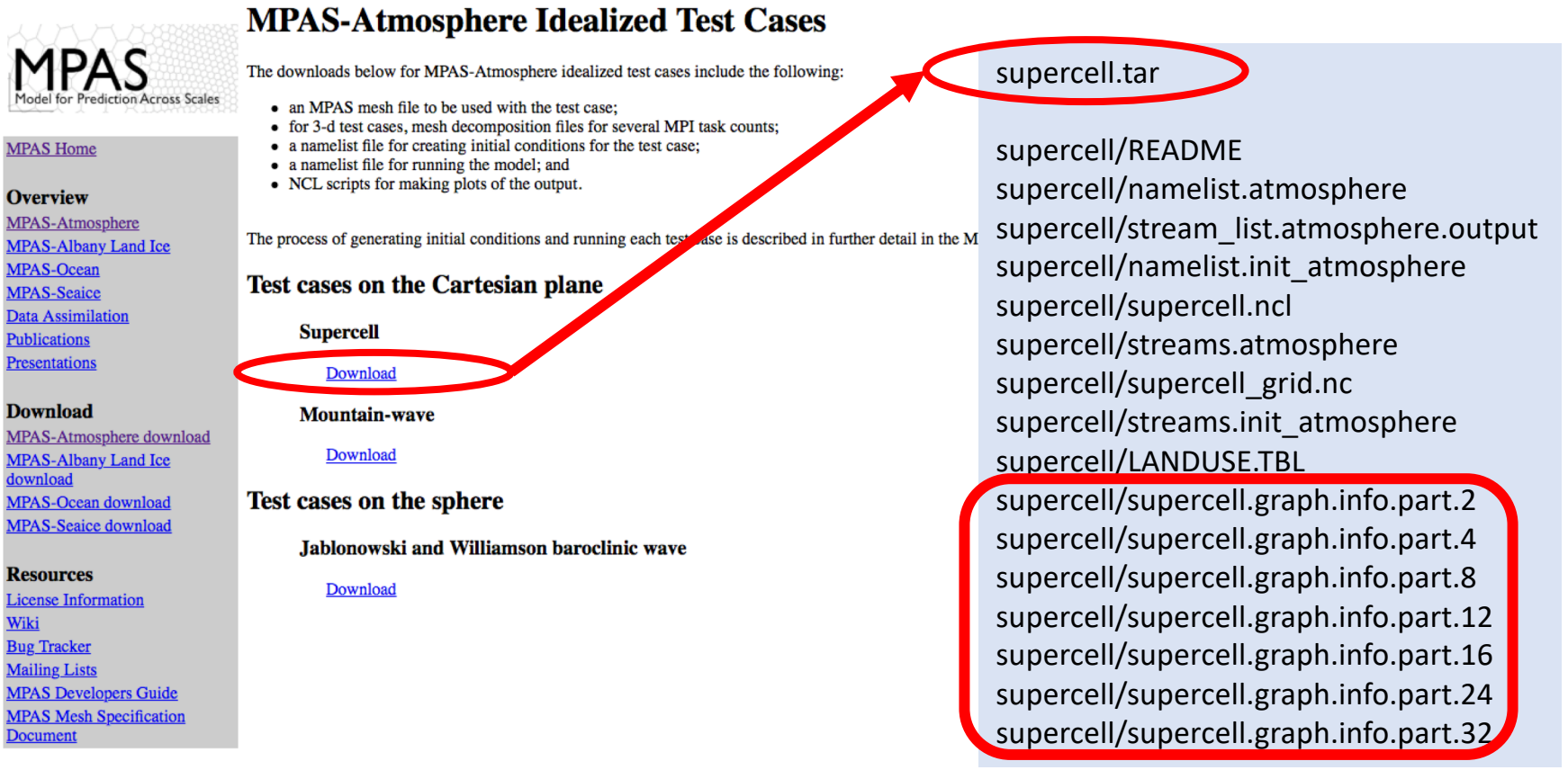


MPAS at T = 5h

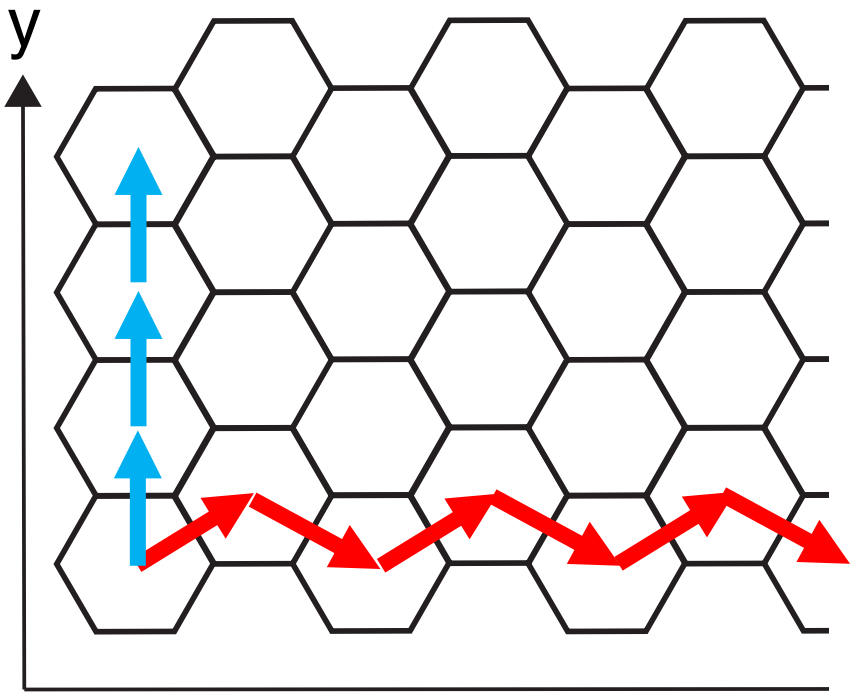


Vertical velocity

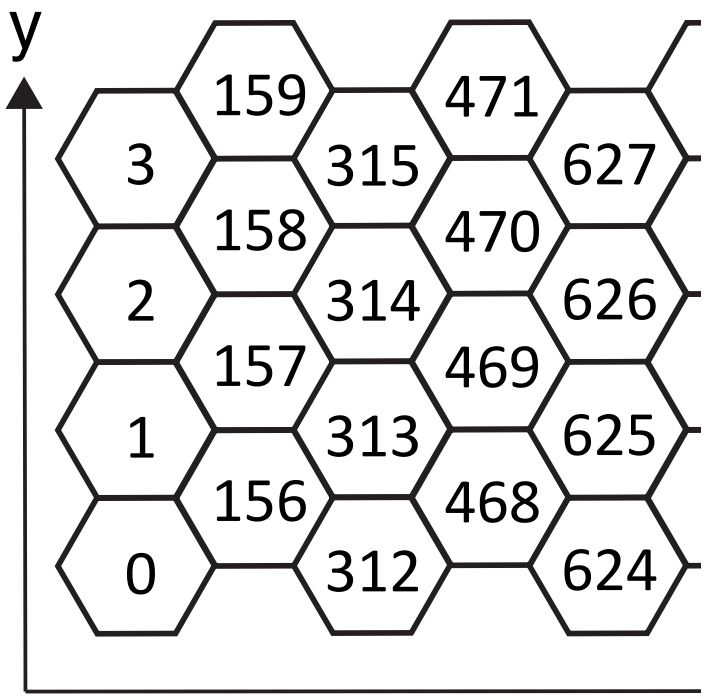
Supercell Test Case– 3D



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

Supercell Test Case

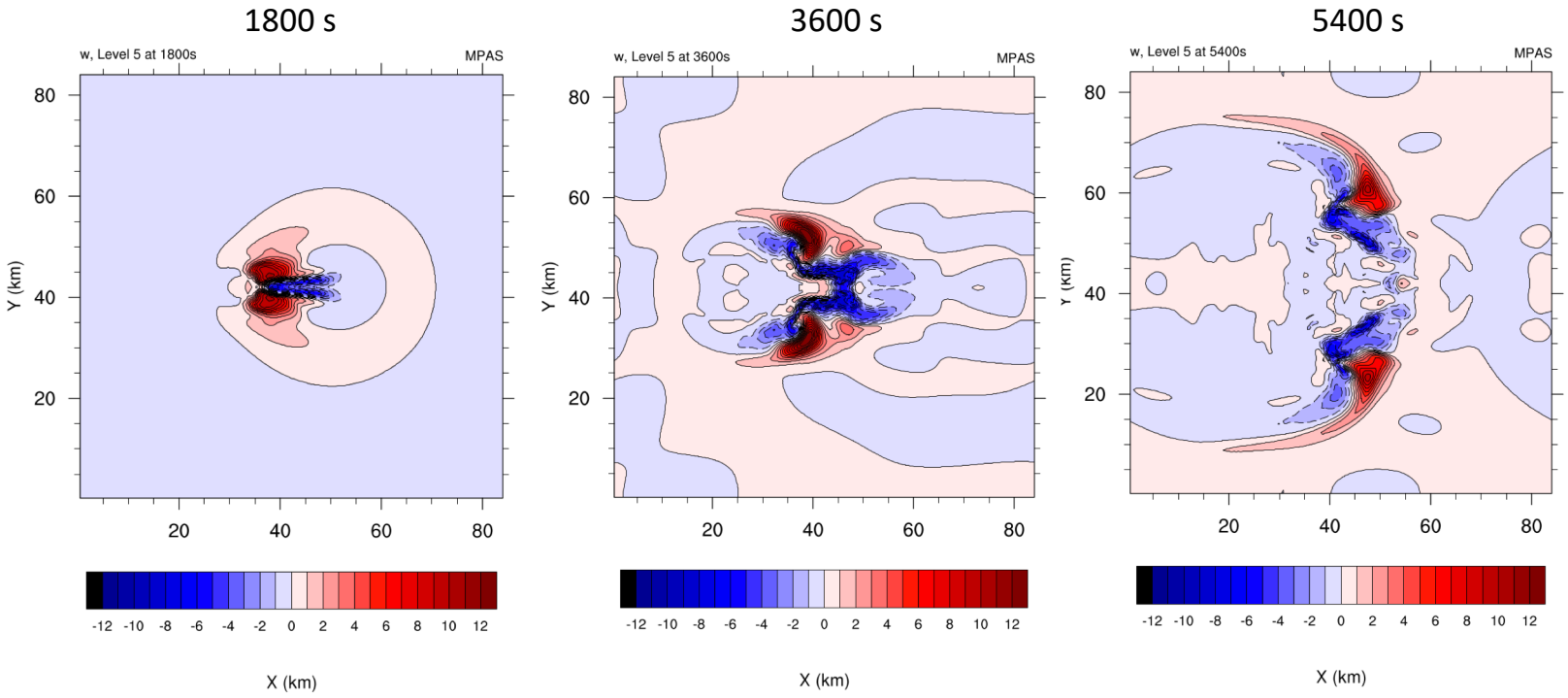
supercell/
namelist.atmosphere

```
&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'
/
```

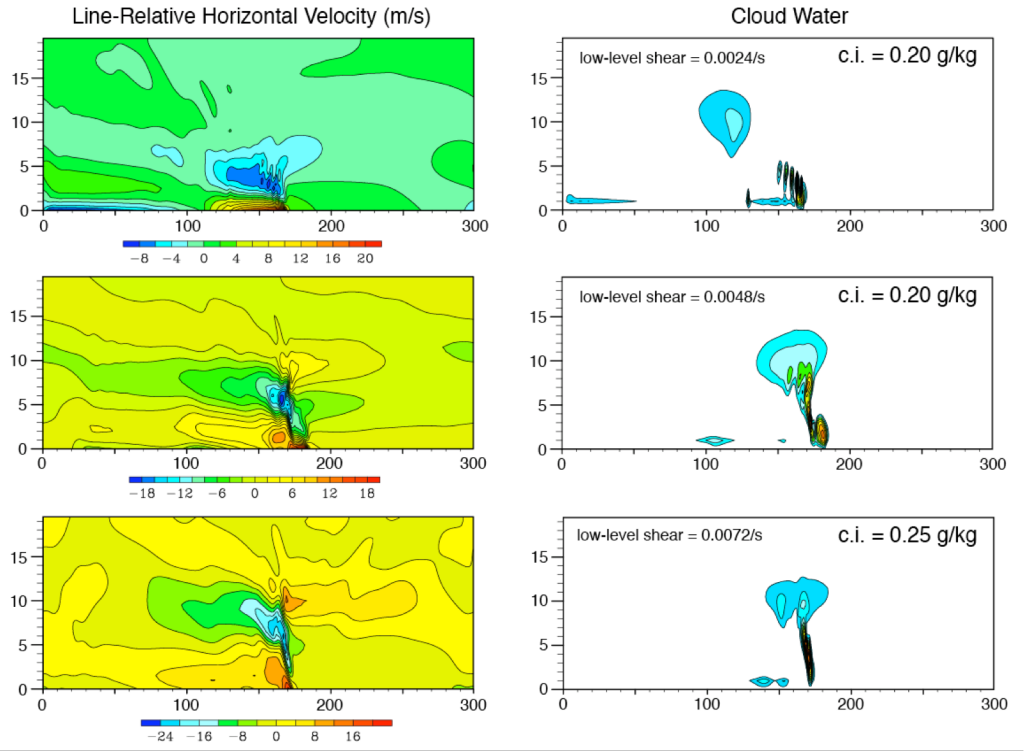
Supercell Test Case

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



Squall-Line Tests

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



(from Max Menchaca)

Jablonowski and Williamson baroclinic wave test case

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Test cases on the sphere

Jablonowski and Williamson baroclinic wave

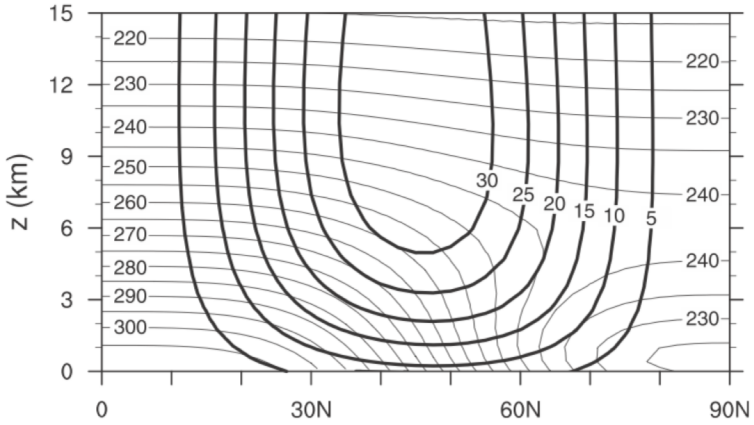
Download

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

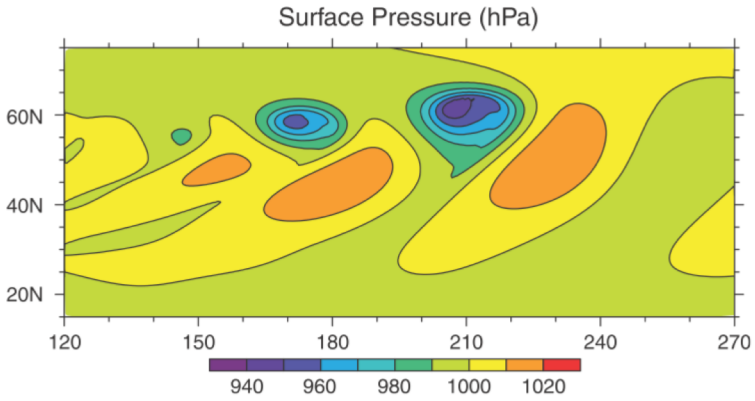
jw_baroclinic_wave.tar

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 baroclinic wave test case



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



Surface pressure at day 9