8ª Reunião Geral do MONAN
03/06/2025
14h00 -16h45

Paulo Yoshio Kubota

Segue link de acesso:
https://conferenciaweb.rnp.br/inpe/8-reuniao-geral-do-monan-terca-feira-17-06-2025

1) Atividade desenvolvidas pelo Grupo de Computação Científica: Apresentadores: Eduardo Khamis
2) Atividade desenvolvidas pelo Grupo de Modelagem de Superfície:Apresentadores:Manzi
3) Atividade desenvolvidas pelo Grupo de Modelagem Oceanos e Criofera Apresentadora: Fernanda Casagrande

14:00-14:05 - Informes Iniciais e Gerais da Chefia com Relação ao MONAN (Chefias/Saulo)
14:05-14:15 - Comentários importantes ou novidades dos Macro-Grupos [GAM, GAD e GMA] obtidos durante a semana sobre o modelo MONAN.
14:15-14:50 - GCC: Atividade desenvolvidas pelo Grupo Computação Científica: [Eduardo Khamis]
14:50-15:00 - Discussão [Todos]
15:00-15:30 - GMS: Atividade desenvolvidas pelo Grupo de Modelagem Atmosférica: [Manzi]
15:30-15:45 - Discussão [Todos]
15:45-16:00 - Intervalo
16:00-16:30 - GMA: Atividades do GMA: [Paulo Kubota]
16:30-16:45 - Discussão [Todos]

Atualização do modelo MONAN com as novas funcionalidades do modelo MPAS-8.3.0
17/06/2025
14h00 -16h45

Paulo Yoshio Kubota

MPAS Version 8.3.0

Latest

MONAN_GPU

Latest

```
diff -br MPAS-Model-8.3.0/CMakeLists.txt MPAS-Model-8.2.3/CMakeLists.txt
diff -br MPAS-Model-8.3.0/Makefile MPAS-Model-8.2.3/Makefile
diff -br MPAS-Model-8.3.0/README.md MPAS-Model-8.2.3/README.md
diff -br MPAS-Model-8.3.0/cmake/Functions/MPAS_Functions.cmake MPAS-Model-8.2.3/cmake/Functions/MPAS_Functions.cmake
diff -br MPAS-Model-8.3.0/src/core_atmosphere/CMakeLists.txt MPAS-Model-8.2.3/src/core_atmosphere/CMakeLists.txt
diff -br MPAS-Model-8.3.0/src/core_atmosphere/Externals.cfg MPAS-Model-8.2.3/src/core_atmosphere/Externals.cfg
diff -br MPAS-Model-8.3.0/src/core_atmosphere/Makefile MPAS-Model-8.2.3/src/core_atmosphere/Makefile
diff -br MPAS-Model-8.3.0/src/core_atmosphere/Registry.xml MPAS-Model-8.2.3/src/core_atmosphere/Registry.xml
diff -br MPAS-Model-8.3.0/src/core_atmosphere/dynamics/mpas_atm_boundaries.F MPAS-Model-8.2.3/src/core_atmosphere/dynamics/mpas_atm_boundaries.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/dynamics/mpas_atm_time_integration.F MPAS-Model-8.2.3/src/core_atmosphere/dynamics/mpas_atm_time_integration.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/mpas_atm_core.F MPAS-Model-8.2.3/src/core_atmosphere/mpas_atm_core.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/mpas_atm_core_interface.F MPAS-Model-8.2.3/src/core_atmosphere/mpas_atm_core_interface.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/.gitignore MPAS-Model-8.2.3/src/core_atmosphere/physics/.gitignore
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/Makefile MPAS-Model-8.2.3/src/core_atmosphere/physics/Makefile
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_control.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_control.F
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diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_driver_gwdo.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_driver_gwdo.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_driver_microphysics.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_driver_microphysics.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_driver_radiation_lw.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_driver_radiation_lw.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_driver_radiation_sw.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_driver_radiation_sw.F
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diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_interface.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_interface.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_lsm_noahmpinit.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_lsm_noahmpinit.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/mpas_atmphys_manager.F MPAS-Model-8.2.3/src/core_atmosphere/physics/mpas_atmphys_manager.F
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diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/physics_wrf/Makefile MPAS-Model-8.2.3/src/core_atmosphere/physics/physics_wrf/Makefile
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/physics_wrf/module_ra_rrtmg_lw.F MPAS-Model-8.2.3/src/core_atmosphere/physics/physics_wrf/module_ra_rrtmg_lw.F
diff -br MPAS-Model-8.3.0/src/core_atmosphere/physics/physics_wrf/module_ra_rrtmg_sw.F MPAS-Model-8.2.3/src/core_atmosphere/physics/physics_wrf/module_ra_rrtmg_sw.F
diff -br MPAS-Model-8.3.0/src/core_init_atmosphere/CMakeLists.txt MPAS-Model-8.2.3/src/core_init_atmosphere/CMakeLists.txt
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diff -br MPAS-Model-8.3.0/src/core_init_atmosphere/mpas_init_atm_core_interface.F MPAS-Model-8.2.3/src/core_init_atmosphere/mpas_init_atm_core_interface.F
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diff -br MPAS-Model-8.3.0/src/core_init_atmosphere/mpas_init_atm_llxy.F MPAS-Model-8.2.3/src/core_init_atmosphere/mpas_init_atm_llxy.F
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diff -br MPAS-Model-8.3.0/src/core_seaice/Registry.xml MPAS-Model-8.2.3/src/core_seaice/Registry.xml
diff -br MPAS-Model-8.3.0/src/core_sw/Registry.xml MPAS-Model-8.2.3/src/core_sw/Registry.xml
diff -br MPAS-Model-8.3.0/src/core_test/Registry.xml MPAS-Model-8.2.3/src/core_test/Registry.xml
diff -br MPAS-Model-8.3.0/src/core_test/mpas_halo_testing.F MPAS-Model-8.2.3/src/core_test/mpas_halo_testing.F
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diff -br MPAS-Model-8.3.0/src/tools/registry/parse.c MPAS-Model-8.2.3/src/tools/registry/parse.c
```

Total = 58 files

Paulo Yoshio Kubota

```
[paulo.kubota@egeon-login sources]$ cat compare_8.3.0_8.2.3.txt | grep .F90| wc -l
1

[paulo.kubota@egeon-login sources]$ cat compare_8.3.0_8.2.3.txt | grep .F| wc -l
32

[paulo.kubota@egeon-login sources]$ cat compare_8.3.0_8.2.3.txt | grep ".c " | wc -l
5

[paulo.kubota@egeon-login sources]$ cat compare_8.3.0_8.2.3.txt | grep ".h " | wc -l
2

[paulo.kubota@egeon-login sources]$ cat compare_8.3.0_8.2.3.txt | grep ".xml " | wc -l
7
```

Esta versão do MPAS introduz novas capacidades e melhorias no modelo MPAS-Atmosphere e em sua infraestrutura de software de suporte. As mudanças mais relevantes estão listadas abaixo.

Inicialização:

•Adição de suporte ao conjunto de dados de categoria de solo BNU com resolução de 30 segundos. O conjunto de dados de categoria de solo BNU de 30” pode ser selecionado definindo a nova opção do namelist config_soilcat_data como 'BNU' no grupo & data_sources do namelist. O uso desse conjunto de dados requer o download separado de um dataset estático. (PR #1322)

•Adição de suporte ao conjunto de dados de uso do solo MODIS com resolução de 15 segundos. O conjunto de dados MODIS de 15” pode ser selecionado definindo a opção existente do namelist config_landuse_data como 'MODIFIED_IGBP_MODIS_NOAH_15s' no grupo &data_sources do namelist. O uso desse conjunto de dados requer o download separado de um dataset estático. (PR #1322)

•Introdução de uma nova opção no namelist, config_lu_supersample_factor, para controlar a superamostragem dos dados de uso do solo, que agora podem estar em uma grade de 30” ou 15”, dependendo da escolha do conjunto de dados. A opção existente config_30s_supersample_factor agora controla a superamostragem apenas para os dados de relevo de 30”, categoria de solo e fração de vegetação mensal MODIS FPAR. (PR #1322)

MPAS Version 8.3.0

Latest

Inicialização:

•Adição de suporte ao conjunto de dados de **categoria de solo BNU** com **resolução de 30 segundos**. O conjunto de dados de categoria de solo BNU de 30” pode ser selecionado definindo a nova opção do namelist **config_soilcat_data** como 'BNU' no grupo & data_sources do namelist. O uso desse conjunto de dados requer o download separado de um dataset estático. (PR #1322)

https://www2.mmm.ucar.edu/wrf/src/wps_files/

Land-Atmosphere Interaction Research Group at Sun Yat-sen University

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Research Projects
Land Models
Land Data
Publications
Research Facilities

The Soil Database of China for Land Surface Modeling

Introduction | Data citation | Data download

Introduction

This soil characteristics database was developed for use in the land surface modeling.

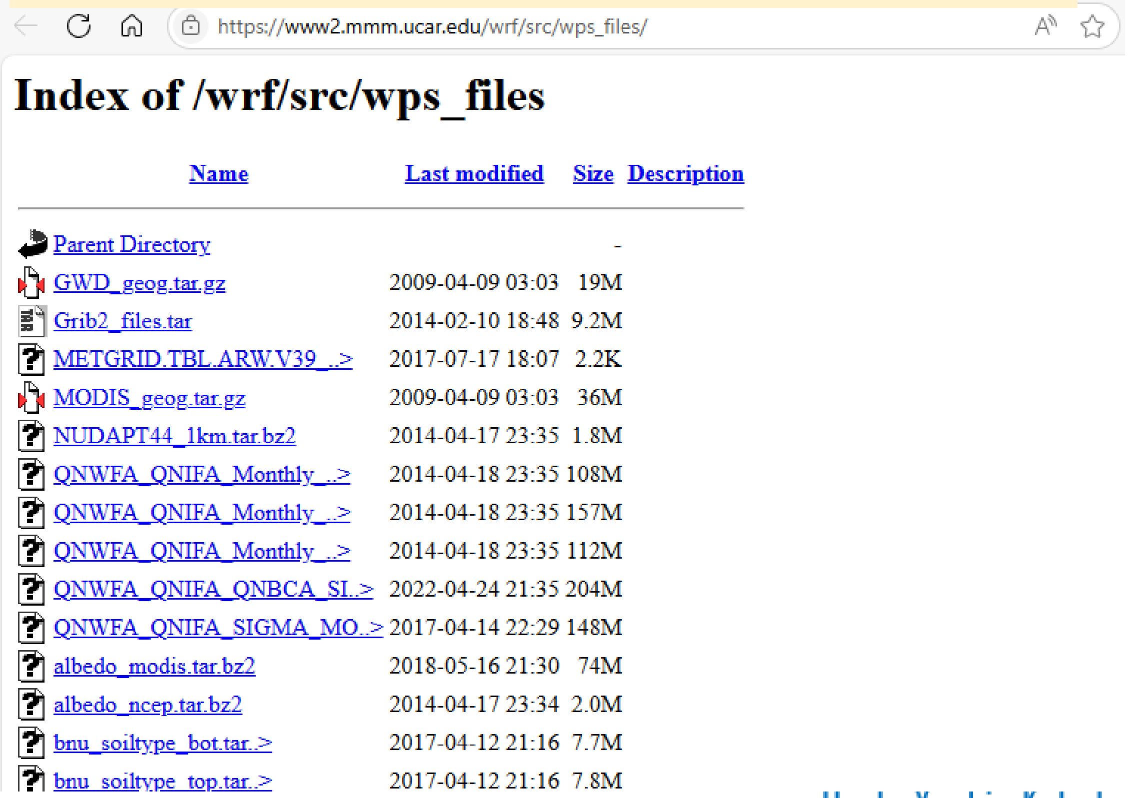
The dataset includes soil physical and chemical attributes: pH value, organic matter fraction, cation exchange capacity, root abundance, total nitrogen (N), total phosphorus (P), total potassium (K), alkali-hydrolysable N, available P, available K, exchangeable H^+, Al^{3+}, Ca^{2+}, Mg^{2+}, K^+, Na^+, horizon thickness, soil profile depth, sand, silt and clay fractions, rock fragment, bulk density, porosity, structure, consistency and soil color. Quality control information (QC) was provided.

The resolution is 30 arc-seconds (about 1 km at the equator). The vertical variation of soil property was captured by eight layers to the depth of 2.3 m (i.e. 0- 0.045, 0.045- 0.091, 0.091- 0.166, 0.166- 0.289, 0.289- 0.493, 0.493- 0.829, 0.829- 1.383 and 1.383- 2.296 m) for convenience of use in the Common Land Model and the Community Land Model (CLM).

The documentation of the dataset can be downloaded here, including readme file and the data citation paper (with its auxiliary material).

Data citation

Shangguan, W., Y. Dai, B. Liu, A. Zhu, Q. Duan, L. Wu, D. Ji, A. Ye, H. Yuan, Q. Zhang, D. Chen, M. Chen, J. Chu, Y. Dou, J. Guo, H. Li, J. Li, L. Liang, X. Liang, H. Liu, S. Liu, C. Miao, and Y. Zhang (2013), A China Dataset of Soil Properties for Land Surface Modeling, Journal of Advances in Modeling Earth Systems, 5: 212-224.



https://www2.mmm.ucar.edu/wrf/src/wps_files/

Index of /wrf/src/wps_files

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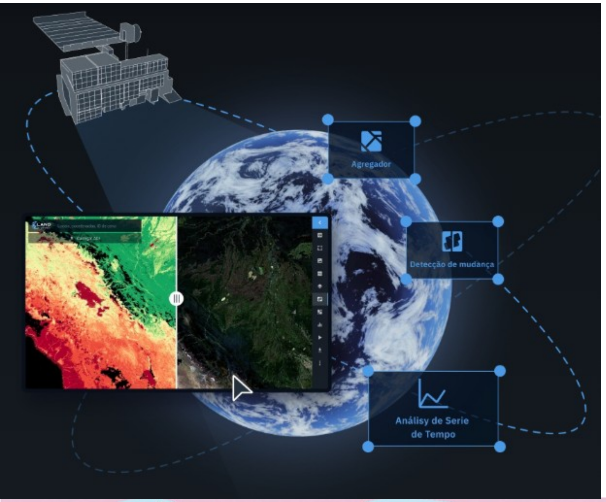
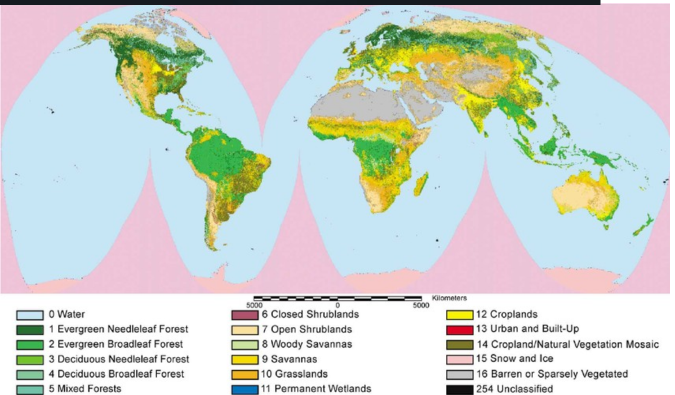
Grib2_files.tar	2014-02-10 18:48	9.2M	
METGRID.TBL.ARW.V39_..>	2017-07-17 18:07	2.2K	
MODIS_geog.tar.gz	2009-04-09 03:03	36M	
NUDAPT44_1km.tar.bz2	2014-04-17 23:35	1.8M	
QNWFA_QNIFA_Monthly_..>	2014-04-18 23:35	108M	
QNWFA_QNIFA_Monthly_..>	2014-04-18 23:35	157M	
QNWFA_QNIFA_Monthly_..>	2014-04-18 23:35	112M	
QNWFA_QNIFA_QNBCA_SI..>	2022-04-24 21:35	204M	
QNWFA_QNIFA_SIGMA_MO..>	2017-04-14 22:29	148M	
albedo_modis.tar.bz2	2018-05-16 21:30	74M	
albedo_ncep.tar.bz2	2014-04-17 23:34	2.0M	
bnu_soiltype_bot.tar..>	2017-04-12 21:16	7.7M	
bnu_soiltype_top.tar..>	2017-04-12 21:16	7.8M	

Paulo Yoshio Kubota

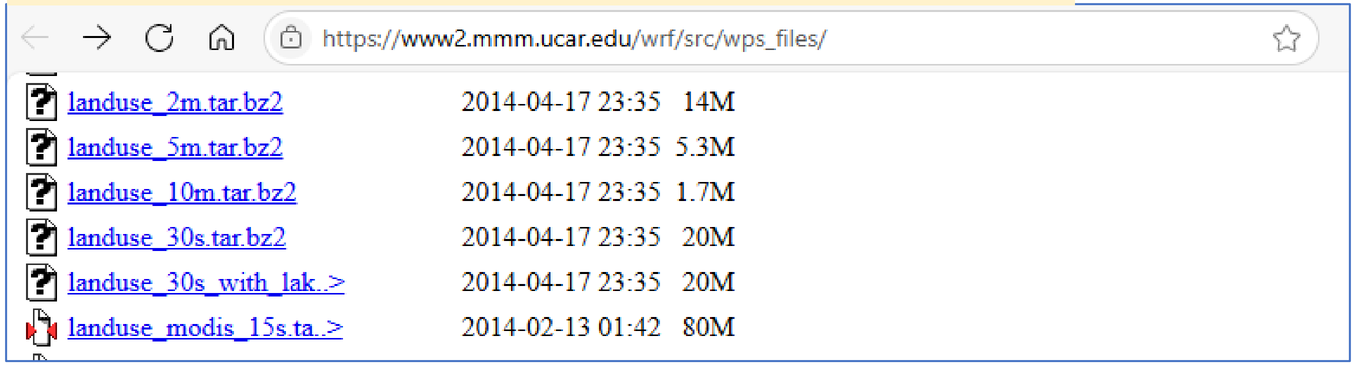
Inicialização:

•Adição de suporte ao conjunto de dados de uso do solo **MODIS com resolução de 15 segundos**. O conjunto de dados MODIS de 15” pode ser selecionado definindo a opção existente do namelist **config_landuse_data** como '**MODIFIED_IGBP_MODIS_NOAH_15s**' no grupo &data_sources do namelist. O uso desse conjunto de dados requer o download separado de um dataset estático. (PR #1322)



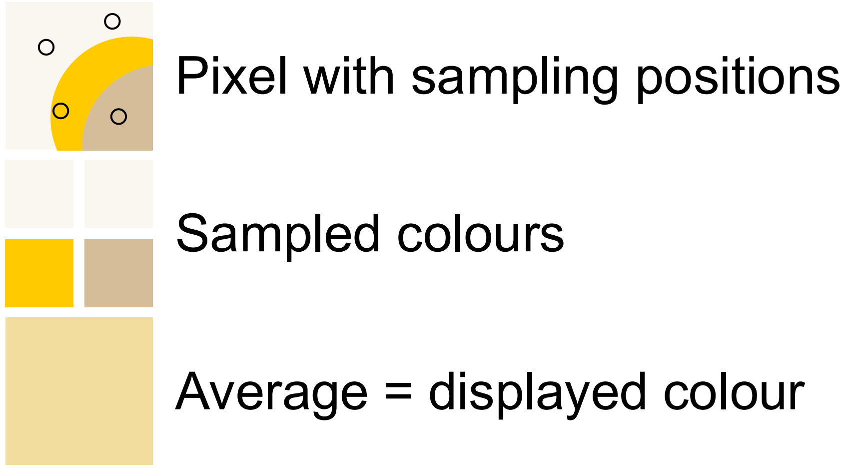


https://www2.mmm.ucar.edu/wrf/src/wps_files/

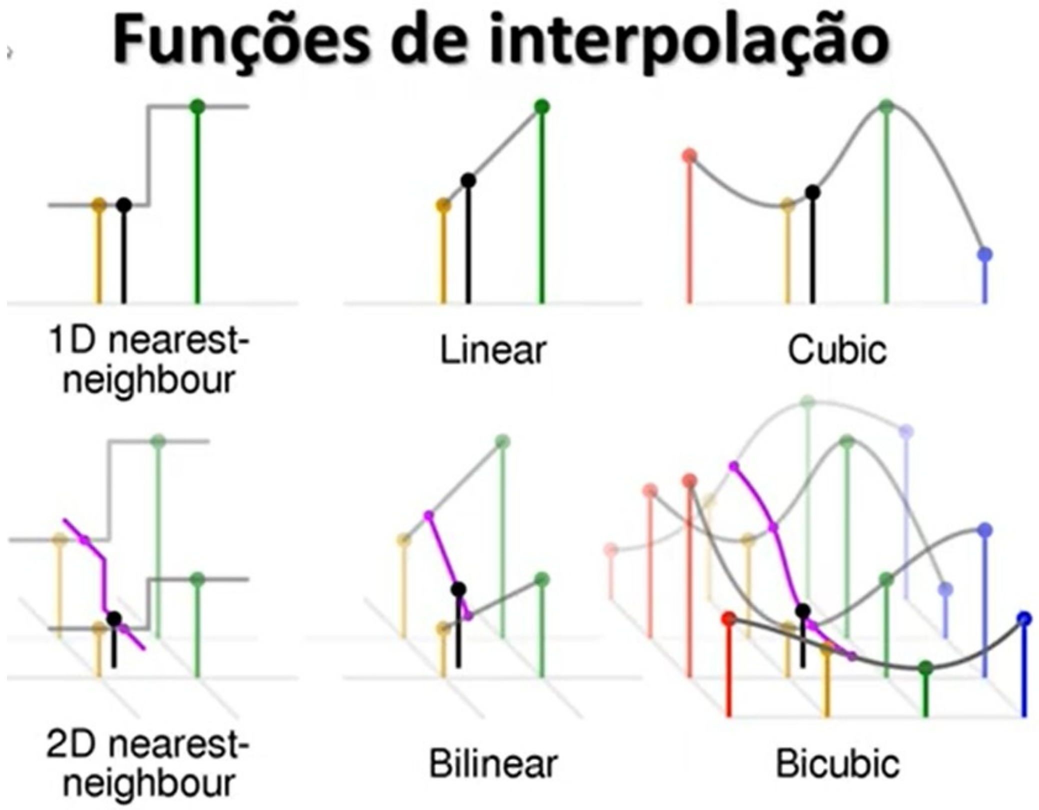


Inicialização:

•Introdução de uma nova opção no namelist, config_lu_supersample_factor, para controlar a superamostragem dos dados de uso do solo, que agora podem estar em uma grade de 30" ou 15", dependendo da escolha do conjunto de dados. A opção existente config_30s_supersample_factor agora controla a superamostragem apenas para os dados de relevo de 30", categoria de solo e fração de vegetação mensal MODIS FPAR. (PR #1322)



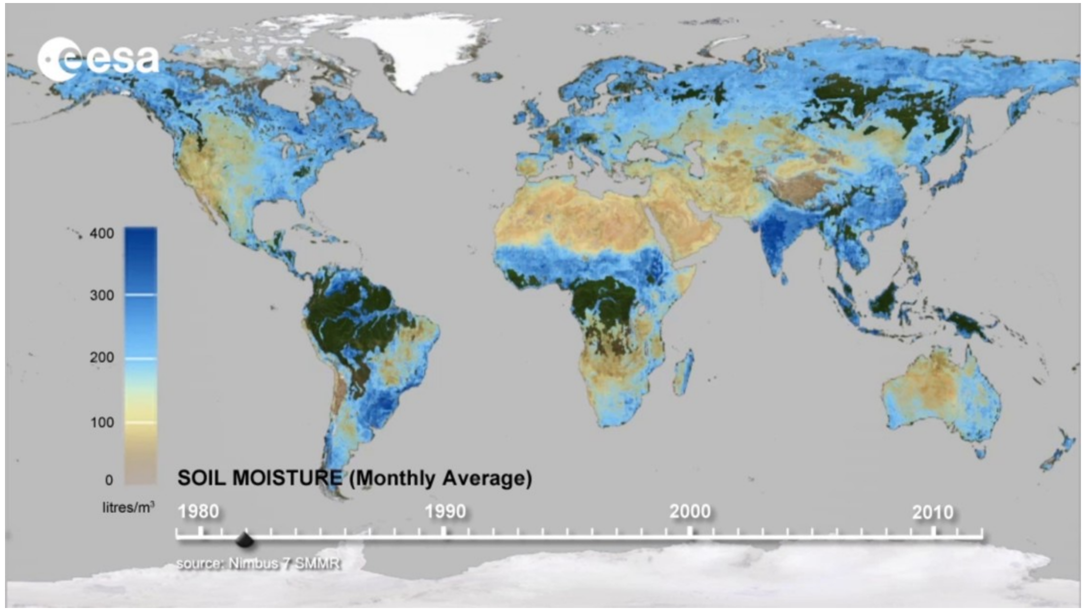
•Alteração na interpolação horizontal, de uma interpolação bilinear de quatro pontos para uma interpolação parabólica sobreposta de dezesseis pontos, tanto para condições iniciais quanto para condições de contorno laterais. (PR #1303)



MPAS Version 8.3.0
[Latest]

MONAN_GPU
[Latest]

- Capacidade de usar campos de umidade do solo e temperatura do solo do ICON. (PR #1298)



Paulo Yoshio Kubota

MPAS Version 8.3.0
Latest

MONAN_GPU
Latest

• Adição de uma opção para ignorar o processamento de campos estáticos exclusivos do Noah-MP no núcleo init_atmosphere. Definir a nova opção do namelist config_noahmp_static como false no grupo &data_sources impede que os campos estáticos do Noah-MP sejam processados quando config_static_interp = true no arquivo namelist.init_atmosphere; isso também permite que arquivos estáticos existentes que não possuem os campos do Noah-MP 'soilcomp', 'soilcl1', 'soilcl2', 'soilcl3' e 'soilcl4' sejam utilizados pelo programa init_atmosphere_model. (PR #1239)


https://www2.mmm.ucar.edu/wrf/src/wps_files/soilgrids/

Index of /wrf/src/wps_files/soilgrids

Name	Last modified	Size	Description
Parent Directory		-	
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texture_bot/	2018-06-05 21:31	-	
texture_layer1/	2018-06-05 21:25	-	
texture_layer2/	2018-06-05 21:30	-	
texture_layer3/	2018-06-05 21:24	-	
texture_layer4/	2018-06-05 21:22	-	
texture_top/	2018-06-05 21:23	-	

Paulo Yoshio Kubota

- Melhorias de escalonamento de memória no processamento do campo estático de arrasto por ondas de gravidade (GWD) no núcleo init_atmosphere (quando config_native_gwd_static = true), para reduzir o uso de memória quando múltiplas tarefas MPI são utilizadas. Em muitos casos, essas mudanças eliminam a necessidade de subutilizar recursos computacionais, o que anteriormente era necessário devido à falta de escalonamento de memória no processamento do campo estático GWD. (PR #1235)

```
 cd WPS_GEOG/
[paulo.kubota@egeon-login WPS_GEOG]$ ls
albedo_modis          hangl   hstdv                 maxsnowalb_modis                    orogwd_1deg   soilgrids         topo_10m
albedo_ncep           hanis   hzmax                 modis_landuse_20class_15s           orogwd_20m    soiltemp_1deg     topo_2m
bnu_soiltype_bot      hasynw  islope                modis_landuse_20class_30s           orogwd_2deg   soiltype_bot_10m  topo_30s
bnu_soiltype_top      hasys   lai_modis_10m         modis_landuse_20class_30s_with_lakes orogwd_30m   soiltype_bot_2m   topo_5m
clayfrac_5m           hasysw  lai_modis_30s         modis_landuse_21class_30s           orogwd3_10m   soiltype_bot_30s  topo_gmted2010_30s
crop                  hasyw   lake_depth            nlcd2006_ll_30s                     orogwd3_1deg  soiltype_bot_5m   topo_ugwp_2m
erod                  hcnvx   landuse_10m           nlcd2006_ll_9s                      orogwd3_20m   soiltype_top_10m  topo_ugwp_30s
geog_noahmp.tar.gz    hlennw  landuse_2m            nlcd2011_can_ll_9s                  orogwd3_2.5m  soiltype_top_2m   varsso
greenfrac             hlens   landuse_30s           nlcd2011_imp_ll_9s                  orogwd3_2deg  soiltype_top_30s  varsso_10m
greenfrac_fpar_modis  hlensw  landuse_30s_with_lakes nudapt44_1km                       orogwd3_30m   soiltype_top_5m   varsso_2m
groundwater           hlenw   landuse_5m            NUDAPT44_1km                        readme        ssib_landuse_10m  varsso_5m
gsl_gwd.tar.bz2       hslop   maxsnowalb            orogwd_10m                          sandfrac_5m   ssib_landuse_5m
[paulo.kubota@egeon-login WPS_GEOG]$ ^C
```

init_atmosphere

Paulo Yoshio Kubota

```
core_init_atmosphere]$ ls
build_options.mk              mpas_atmphys_initialize_real.F  mpas_init_atm_core.F            mpas_init_atm_read_met.F            mpas_stack.F
CMakeLists.txt                mpas_atmphys_utilities.F        mpas_init_atm_core_interface.F  mpas_init_atm_static.F              read_geogrid.c
Makefile                      mpas_geotile_manager.F          mpas_init_atm_gwd.F             mpas_init_atm_surface.F             Registry.xml
mpas_atm_advection.F          mpas_gsl_oro_data_lg_scale.F    mpas_init_atm_gwd_gsl.F         mpas_init_atm_thompson_aerosols.F
mpas_atmphys_constants.F      mpas_gsl_oro_data_sm_scale.F    mpas_init_atm_hinterp.F         mpas_init_atm_vinterp.F
mpas_atmphys_date_time.F      mpas_init_atm_bitarray.F        mpas_init_atm_llxy.F            mpas_kd_tree.F
mpas_atmphys_functions.F      mpas_init_atm_cases.F           mpas_init_atm_queue.F           mpas_parse_geoindex.F
```

orogwd3_2.5m/

```
conls(iCell)    = conss(iCell)       conss
oa1ls(iCell)    = oa1ss(iCell)       oa1ss
oa2ls(iCell)    = oa2ss(iCell)       oa2ss
oa3ls(iCell)    = oa3ss(iCell)       oa3ss
oa4ls(iCell)    = oa4ss(iCell)       oa4ss
ol1ls(iCell)    = ol1ss(iCell)       ol1ss
ol2ls(iCell)    = ol2ss(iCell)       ol2ss
ol3ls(iCell)    = ol3ss(iCell)       ol3ss
ol4ls(iCell)    = ol4ss(iCell)       ol4ss
var2dls(iCell)  = var2dss(iCell)     varss
```

MPAS Version 8.3.0
[Latest]

MONAN_GPU
[Latest]

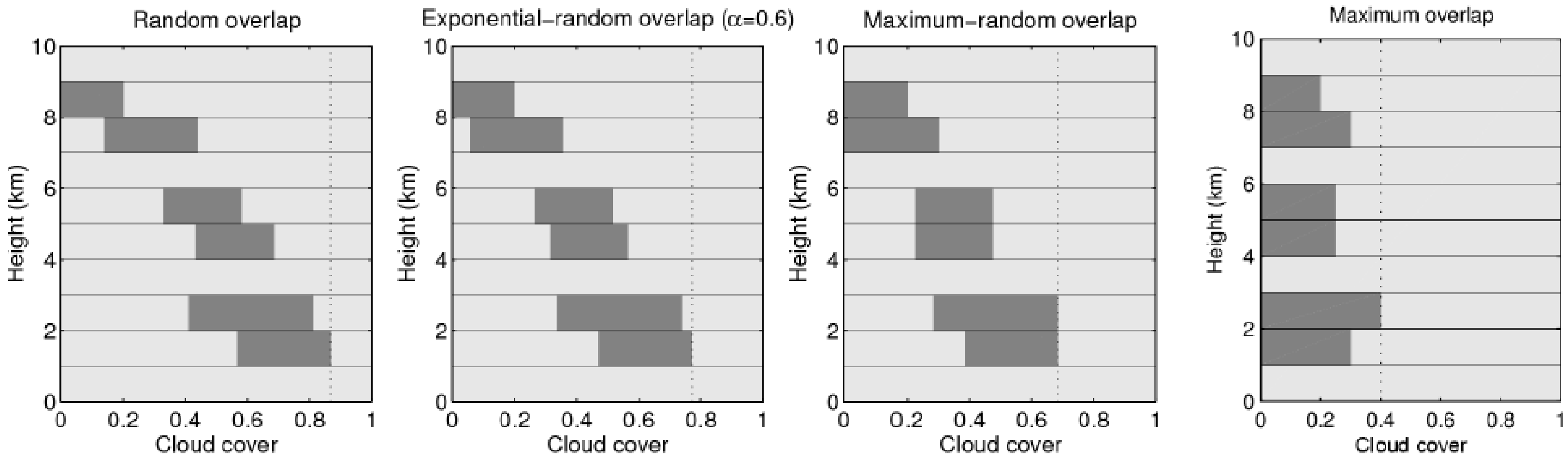
Física:

•Atualização dos esquemas RRTMG LW e SW, com destaque para a adição das suposições de sobreposição de nuvens do tipo exponencial e exponencial_aleatória. A suposição de sobreposição de nuvens e o comprimento de decorrelação agora estão disponíveis como opções no namelist (config_radt_cld_overlap e config_radt_cld_dcorrlen, respectivamente). (PR #1296 e PR #1297)

Parametrização de sobreposição de nuvem

- Mesmo que possa prever a fração de nuvens versus altura.

=> A cobertura de nuvens (e, portanto, a radiação) **depende da sobreposição de nuvens**

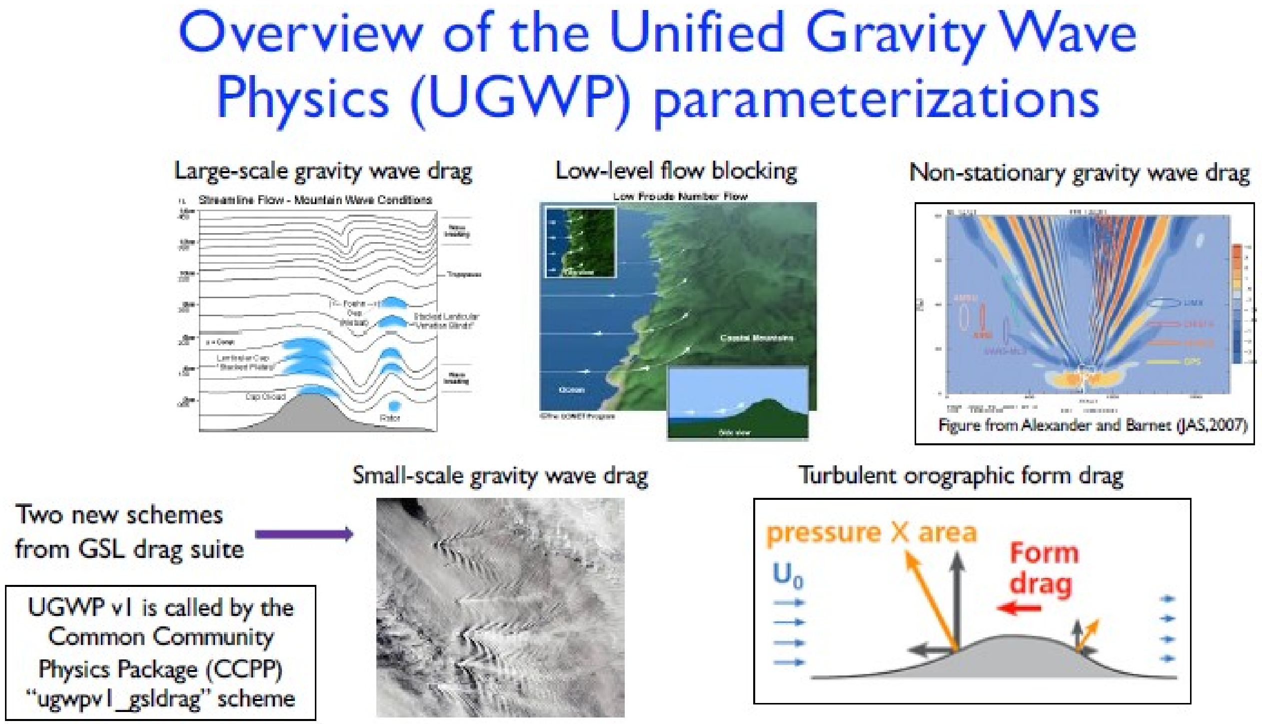


- Observações (Hogan e Illingworth 2000) suportam "sobreposição aleatória exponencial":
- – Nuvens não adjacentes são sobrepostas aleatoriamente
- – Nuvens adjacentes correlacionadas com comprimento de decorrelação ~2km
- – Muitos modelos ainda usam "sobreposição aleatória máxima"

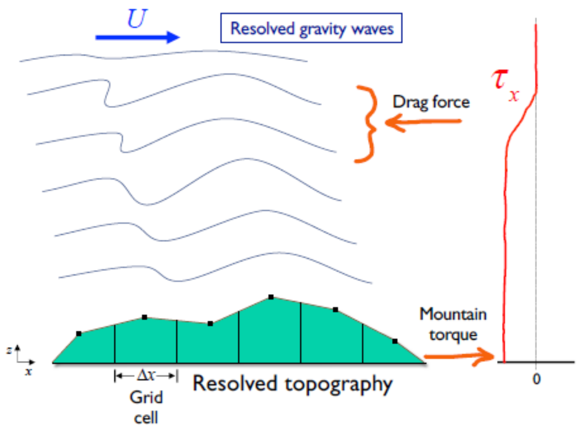
...o Yoshio Kubota

Física:

•Incorporação do conjunto de parametrizações físicas UGWP (Unified Gravity Wave Physics) do Sistema de Previsão Unificado (UFS) da NOAA. Esse pacote físico é a suíte de arrasto orográfico por ondas de gravidade (GWD) "NOAA/GSL", introduzida no WRF Versão 4.3 (ativada pela opção do namelist do WRF gwd_opt=3), mas com a adição de uma parametrização GWD não-estacionária que representa fontes de ondas de gravidade como convecção profunda e instabilidade frontal. O uso da suíte UGWP requer downloads adicionais de campos estáticos. (PR #1276)



Large-scale gravity wave drag parameterization



Wave stress: $\tau_x = \bar{\rho}\,\overline{u'w'}$

(vertical momentum flux, N/m²)

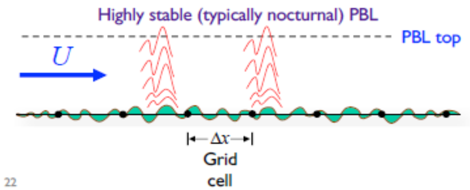
Drag: $\left(\frac{\partial U}{\partial t}\right)_{drag} = -\frac{1}{\bar{\rho}}\frac{\partial \tau_x}{\partial z}$

15

"Small-scale" GSL drag suite schemes

Small-scale gravity wave drag (SSGWD) in stable PBLs
Tsiringakis et al. (2017); Steenveld et al. (2008)

- Highly stable PBL allows vertical propagation of gravity waves at smaller horizontal scales
- Drag force imparted throughout PBL depth
- Useful for grid resolutions > 1 km



From Tsiringakis et al. (QJRMS, 2017):

Surface stress: $\tau_0 = \begin{cases} \frac{1}{2}\rho_0 k H^2 N \bar{u}, & \text{if } \frac{N}{\bar{u}} \geq k \\ 0, & \text{if } \frac{N}{\bar{u}} < k \end{cases}$ Vertical propagation / Trapped waves

Vertical stress profile: $\tau(z) = \tau_0\left(1-\frac{z}{h}\right)^2$ h = PBL height

Where: $H = 2\sigma_h$ (2 x std dev of subgrid topography)

$k = \frac{(1+L_x)^{OA}}{\lambda_{eff}}$ Horizontal wave number of topog.

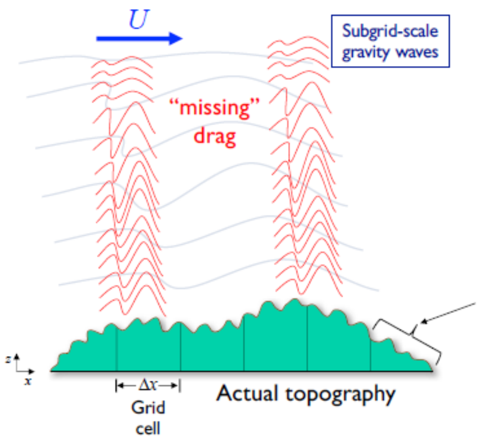
L_x, OA and λ_{eff} Parameters from Kim and Doyle (2005)

"This scheme can be thought of as an extension of the Kim and Arakawa scheme to within the PBL" -- paraphrasing Tsiringakis et al. (2017)

(In the future the schemes should be unified.)

22

Large-scale gravity wave drag parameterization



Parameterized wave stress: $\tau_x = \bar{\rho}\,\overline{u'w'}$

Parameterized drag: $\left(\frac{\partial U}{\partial t}\right)_{drag} = -\frac{1}{\bar{\rho}}\frac{\partial \tau_x}{\partial z}$

Standard deviation of subgrid topography within each grid cell is used as proxy for mountain height for surface stress calculation

"Small-scale" GSL drag suite schemes

Wind speed tendency from drag:

$$\left(\frac{\partial \mathbf{U}}{\partial t}\right)_{TOFD} = -\alpha\beta C_{md} C_{corr} |\mathbf{U}(z)| \mathbf{U}(z) 2.109\, e^{-(z/1500)^{1.5}} a_2 z^{-1.2}$$

30sec topographic data is band-passed filtered before calculating subgrid standard deviation:

1344 A. C. M. BELJAARS et al.

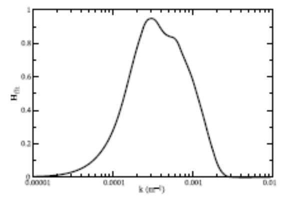
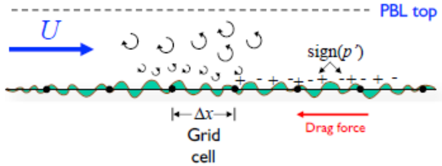


Figure A.2. Spectral filter corresponding to difference of two smoothing operations with: $\lambda_1 = 2$ km, $\lambda_2 = 20$ km, $\delta_1 = \delta_2 = 1$ km.

Turbulent orographic form drag (TOFD)
Beljaars et al. (2004)

- Positively correlated turbulent pressure perturbations and terrain slope cause an opposing drag force (Note: This is not gravity wave drag)
- Drag force decays exponentially with height (e-folding height is ~ 1.5 km)
- Terrain height is band-pass filtered to remove horizontal variations >20 km and <2 km before calculating the standard deviation of the subgrid topography
- Useful for grid resolutions > 1 km



23

Paulo Yoshio Kubota

MPAS Version 8.3.0 [Latest] → **MONAN_GPU** [Latest]

Dinâmica:

•Portabilidade completa de todas as rotinas do núcleo dinâmico para GPUs utilizando diretivas OpenACC, incluindo rotinas usadas por simulações de área limitada. Contudo, esta versão **não inclui** a otimização da movimentação de dados entre a memória da CPU e da GPU, nem o perfilamento e a otimização dos núcleos computacionais.

Parallelizing a single loop

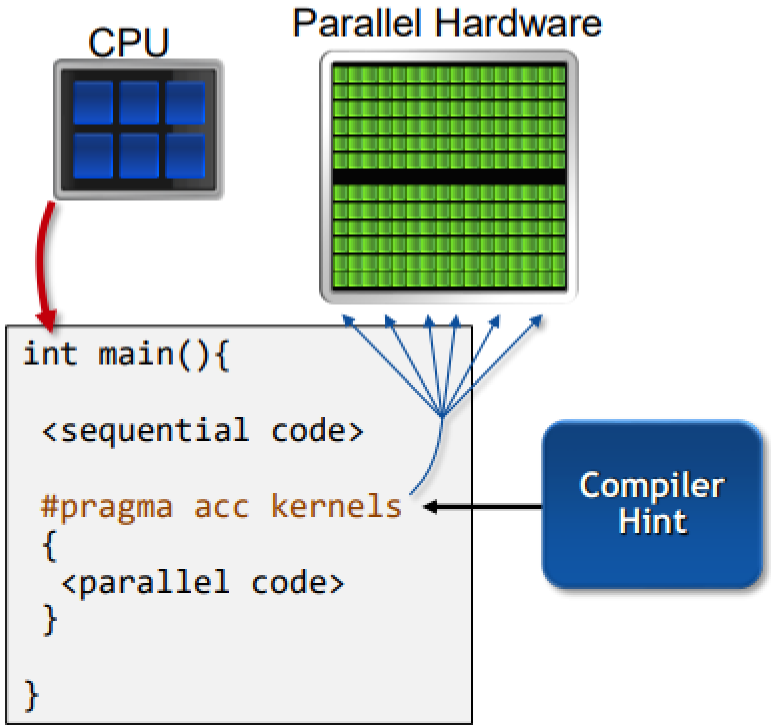
C/C++

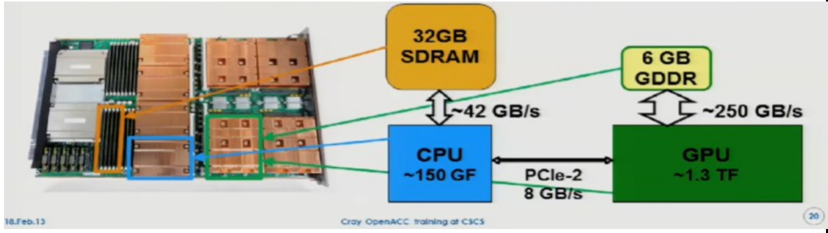
```c
#pragma acc parallel loop
for(int i = 0; j < N; i++)
  a[i] = 0;
```

Fortran

```fortran
!$acc parallel loop
do i = 1, N
  a(i) = 0
end do
```

OpenACC NVIDIA aws Linux Academy





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MPAS Version 8.3.0

[Latest]

MONAN_GPU

[Latest]

```
subroutine halo_exchange_routine
subroutine mpas_atm_dynamics_checks
subroutine mpas_atm_dynamics_init
subroutine mpas_atm_dynamics_finalize
subroutine atm_timestep
subroutine atm_srk3
subroutine advance_scalars
subroutine atm_rk_integration_setup
subroutine atm_compute_moist_coefficients
subroutine atm_compute_vert_imp_coefs
subroutine atm_compute_vert_imp_coefs_work
atm_set_smlstep_pert_variables
subroutine atm_set_smlstep_pert_variables_work
subroutine atm_advance_acoustic_step
subroutine atm_advance_acoustic_step_work
subroutine atm_divergence_damping_3d
subroutine atm_recover_large_step_variables
subroutine atm_recover_large_step_variables_work
subroutine atm_advance_scalars
subroutine atm_advance_scalars_work
subroutine atm_advance_scalars_mono
subroutine atm_advance_scalars_mono_work
subroutine atm_compute_dyn_tend
subroutine atm_compute_dyn_tend_work
subroutine atm_compute_solve_diagnostics
subroutine atm_compute_solve_diagnostics_work
subroutine atm_init_coupled_diagnostics
subroutine atm_rk_dynamics_substep_finish
subroutine atm_zero_gradient_w_bdy
subroutine atm_zero_gradient_w_bdy_work
subroutine atm_bdy_adjust_dynamics_speczone_tend
subroutine atm_bdy_adjust_dynamics_relaxzone_tend
subroutine atm_bdy_reset_speczone_values
subroutine atm_bdy_adjust_scalars
subroutine atm_bdy_adjust_scalars_work
subroutine atm_bdy_set_scalars
subroutine atm_bdy_set_scalars_work
subroutine summarize_timestep

subroutine atm_advance_scalars_work_coldpool
subroutine atm_advance_scalars_mono_work_coldpool
```

```
!$acc parallel
        !
        !  horizontal flux divergence
        !
        !$acc loop gang worker private(ica, swa)
        do iEdge=edgeStart,edgeEnd
           cell1 = cellsOnEdge(1,iEdge)
           cell2 = cellsOnEdge(2,iEdge)
           if (cell1 <= nCellsSolve .or. cell2 <= nCellsSolve) then  ! only for owned cells
              ! special treatment of calculations involving edges between hexagonal cells
              ! original code retained in select "default" case
              ! be sure to see additional declarations near top of subroutine
              select case(nAdvCellsForEdge(iEdge))
              case(10)
                 !$acc loop vector
                 do jj=1,10
                    ica(jj)    = advCellsForEdge(jj,iEdge)
                    swa(jj,1)  = adv_coefs(jj,iEdge) + adv_coefs_3rd(jj,iEdge)
                    swa(jj,2)  = adv_coefs(jj,iEdge) - adv_coefs_3rd(jj,iEdge)
                 end do
                 !$acc loop vector
                 do k=1,nVertLevels
                    ii = merge(1, 2, uhAvg(k,iEdge) > 0)
                    flux_arr(k,iEdge) = uhAvg(k,iEdge)*( &
                         swa(1,ii)*scalar_new(k,ica(1)) + swa(2,ii)*scalar_new(k,ica(2)) + &
                         swa(3,ii)*scalar_new(k,ica(3)) + swa(4,ii)*scalar_new(k,ica(4)) + &
                         swa(5,ii)*scalar_new(k,ica(5)) + swa(6,ii)*scalar_new(k,ica(6)) + &
                         swa(7,ii)*scalar_new(k,ica(7)) + swa(8,ii)*scalar_new(k,ica(8)) + &
                         swa(9,ii)*scalar_new(k,ica(9)) + swa(10,ii)*scalar_new(k,ica(10)))
                 end do
              case default
                 !$acc loop vector
                 do k=1,nVertLevels
                    flux_arr(k,iEdge) = 0.0_RKIND
                 end do

              end select
           else
             ......................
.....................................
           end if
        end do
!$acc end parallel
```

Incluiu-se as directivas openacc

Dinâmica:

•Alteração na condição de contorno de **gradiente zero** para *w* (velocidade vertical) para um <u>**valor constante de *w = 0***</u> em uma zona específica.

Para configurações de área limitada, <u>***essa mudança***</u> de uma condição de contorno de gradiente zero para a velocidade vertical para uma configuração onde *w = 0*, <u>***ajuda a reduzir feições espúrias e instabilidades que apareciam próximas às fronteiras***</u> em regiões com forte escoamento de entrada. (PR #1304)

Within the relaxation region, the MPAS prognostic equations for horizontal and vertical momentum, potential temperature, density, and moisture (vapor and condensates) are augmented by a Rayleigh damping term and a second-order horizontal diffusion of the form

$$\frac{\partial \phi}{\partial t} = \mathrm{RHS}_\phi + F_1(\phi_{LS} - \phi) - F_2 \Delta x^2 \nabla^2 (\phi_{LS} - \phi), \quad (1)$$

where

$$F_1 = \gamma_1 (i - 1)/m, \quad F_2 = \gamma_2 (i - 1)/m, \quad (2)$$

for cells $i = 2, \ldots, m$ in the relaxation region, ϕ is the model state, and ϕ_{LS} is the large-scale driving solution.

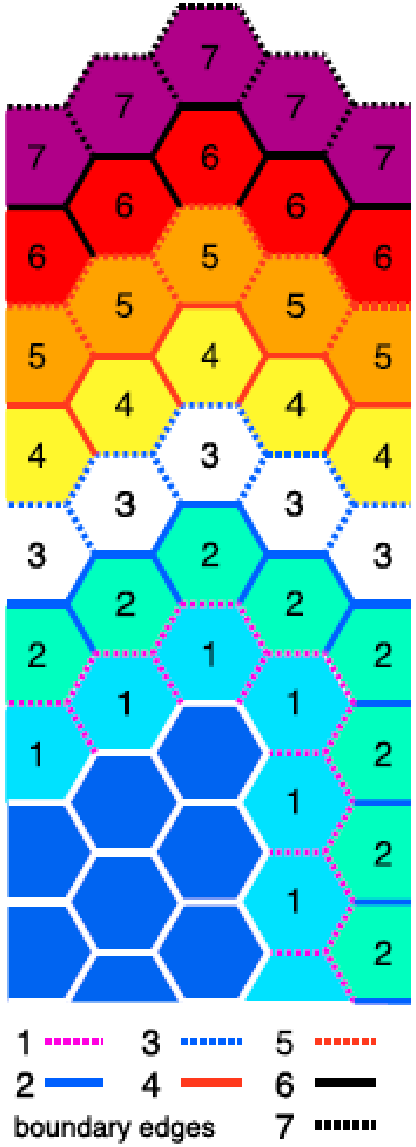

FIG. 3. Boundary zone for the MPAS horizontal mesh. The blue cells are the interior mesh, and the labeled cells and edges are in the boundary region.

Infraestrutura:

•Implementação de uma nova funcionalidade para gerar automaticamente o código lógico de pacotes, que determina quando um pacote está ativo. Essa lógica para gerar pacotes é criada pelo *registry* durante o processo de compilação, por meio do uso de um novo atributo XML, active_when, aplicado aos elementos. (PR #1321)

```
int parse_reg_xml(ezxml_t registry)/*{{{*/
{
	ezxml_t dims_xml, dim_xml;
	ezxml_t structs_xml, var_arr_xml, var_xml;
	ezxml_t nmlrecs_xml, nmlopt_xml;
	ezxml_t packages_xml, package_xml;
	ezxml_t streams_xml, stream_xml;
	int err;
	// Parse Packages
	err = parse_packages_from_registry(registry);
	if (err) {
		fprintf(stderr, "Error in parse_packages_from_registry\n");
		return err;
	}
	// Parse namelist records
	err = parse_namelist_records_from_registry(registry);
	if (err) {
		fprintf(stderr, "Error in parse_namelist_records_from_registry\n");
		return err;
	}
	// Parse dimensions
	err = parse_dimensions_from_registry(registry);
	if (err) {
		fprintf(stderr, "Error in parse_dimensions_from_registry\n");
		return err;
	}
	// Parse variable structures
	err = parse_structs_from_registry(registry);
	if (err) {
		fprintf(stderr, "Error in parse_structs_from_registry\n");
		return err;
	}
	// Generate logic to set packages with the 'active_when' attribute
	err = generate_package_logic(registry);
	if (err) {
		fprintf(stderr, "Error in generate_package_logic\n");
		return err;
	}
    return 0;
}/*}}}
```

```
for (packages_xml = ezxml_child(registry, "packages"); packages_xml; packages_xml = packages_xml->next) {
		for (package_xml = ezxml_child(packages_xml, "package"); package_xml; package_xml = package_xml->next) {
			const char *packagename, *packagewhen;

			packagename = ezxml_attr(package_xml, "name");
			packagewhen = ezxml_attr(package_xml, "active_when");

			if (packagewhen != NULL) {
				fortprintf(fd, "       call %s_setup_%s_package(configPool, packagePool)\n", corename, packagename);
			}
		}
	}

	fortprintf(fd, "\n");
	fortprintf(fd, "      call mpas_log_write('----- done configuring registry-specified packages -----')\n");
	fortprintf(fd, "      call mpas_log_write('')\n");
	fortprintf(fd, "\n");
	fortprintf(fd, "   end function %s_setup_packages_when\n", corename);
	fortprintf(fd, "\n");

	for (packages_xml = ezxml_child(registry, "packages"); packages_xml; packages_xml = packages_xml->next) {
		for (package_xml = ezxml_child(packages_xml, "package"); package_xml; package_xml = package_xml->next) {
			const char *packagename, *packagewhen;

			packagename = ezxml_attr(package_xml, "name");
			packagewhen = ezxml_attr(package_xml, "active_when");

			if (packagewhen != NULL) {
				if (package_logic_routine(fd, &preg, corename, packagename, packagewhen, registry) != 0) {
					fprintf(stderr, "Error: Problem generating logic routine for package %s, active when (%s)\n", packagename, packagewhen);
					regfree(&preg);
					fclose(fd);
					return 1;
				}
			}
		}
	}
```

```xml
<!-- ************************************************************************************ -->
<!-- ************************************  Packages  ************************************ -->
<!-- ************************************************************************************ -->

        <packages>
                <package name="mp_kessler_in" description="parameterization of kessler microphysics."/>
                <package name="mp_thompson_in" description="parameterization of Thompson cloud microphysics."/>
                <package name="mp_thompson_aers_in" description="parameterization of aerosol-aware Thompson cloud microphysics."/>
                <package name="mp_wsm6_in" description="parameterization of WSM6 cloud microphysics."/>
                <package name="cu_grell_freitas_in" description="parameterization of Grell-Freitas convection."/>
                <package name="cu_gf_monan_in" description="parameterization of Grell-Freitas convection used in MONAN."/>
                <package name="cu_kain_fritsch_in" description="parameterization of Kain-Fritsch convection."/>
                <package name="cu_ntiedtke_in" description="parameterization of Tiedtke convection."/>
                <package name="bl_ysu_in" description="parameterization of YSU Planetary Boundary Layer."/>
                <package name="bl_mynn_in" description="parameterization of MYNN Planetary Boundary Layer."/>
                <package name="sf_noahmp_in" description="parameterization of NOAH-MP land surface scheme."/>

                <package name="iau" description="Incremental Analysis Update"/>
                <package name="limited_area" description="Limited-area simulations, which have lateral boundaries"/>
                <package name="jedi_da" description="Data Assimilation in JEDI framework"/>
                <package name="no_invariant_stream" description="No separate invariant I/O stream is active"/>
                <package name="ugwp_orog_stream" description="Input stream (and variables) for UGWP orography"/>
                <package name="ugwp_ngw_stream"  description="Input stream (and variables) for UGWP NGW lookup table"/>
                <package name="ugwp_diags_stream" description="Output stream (and variables) for UGWP output diagnostics"/>

                <!-- GF-MONAN packages for sub-options -->
                <package name="gf_monan_gustf" description="GF-MONAN gust front effects on surface fluxes"/>
                <package name="gf_monan_cporg" description="GF-MONAN cold pool edge effects on convection organization"/>
                <package name="gf_monan_pcvol" description="GF-MONAN passive cloud volume"/>
                <package name="gf_monan_sub3d" description="GF-MONAN 3d lateral spreading of the env subsidence"/>

        </packages>
```

Outros:

•Adição de um novo script Python para configurar os diretórios de execução do MPAS-Atmosphere. (PR #1326)

•Adição da refletividade de radar 3D de 10 cm (refl10cm) ao *stream* da_state, útil para assimilação de dados de radar (*radar DA*) e comparação com observações de radar. (PR #1323)

Este *pull request* incorpora o conjunto de parametrizações físicas **UGWP (Unified Gravity Wave Physics)** do **Sistema Unificado de Previsão (UFS)** da **NOAA** ao **MPAS**:
🔗 https://ufs.epic.noaa.gov/wp-content/uploads/2021/07/UGWP_in_UFS_July_2021-1.pdf
A seguir, um breve resumo sobre o uso do conjunto:

1.No núcleo init_atmosphere, há uma nova opção de pré-processamento estático, config_native_gwd_gsl_static, que é usada para gerar um novo arquivo estático necessário ao UGWP. O arquivo é escrito pelo *stream* ugwp_oro_data e requer dois novos conjuntos de dados no diretório de dados geográficos: topo_ugwp_30s e topo_ugwp_2.5m.

2.No núcleo atmosphere, há várias novas opções quando config_gwdo_scheme = 'bl_ugwp_gwdo':

- config_ngw_scheme
- config_knob_ugwp_tauamp
- config_ugwp_diags

3.Se config_ngw_scheme = true, um arquivo de entrada adicional, ugwp_limb_tau.nc, é necessário. Essa opção ativa o esquema de arrasto de ondas de gravidade não-estacionário.

4.Se config_ugwp_diags = true, o *stream* de saída diag_ugwp será escrito.
Nota: Este pacote físico é o conjunto "NOAA/GSL" de arrasto orográfico por ondas de gravidade (*GWD*), introduzido no **WRF versão 4.3** (ativado com gwd_opt=3 no namelist). Ele inclui uma parametrização GWD não-estacionária que representa fontes de ondas de gravidade como convecção profunda e instabilidade frontal.

MPAS Version 8.3.0

[Latest](#)

MONAN_GPU

[Latest](#)