

South Caucasus-Black Sea Regional Climate Conference

Introduction to the RegCM4 system

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The RegCM4 System

Steps for Regional Climate Physical Downscaling



- Area of interest localization
- Interpolation of initial and boundary conditions
- Time integrator with multiple physical options
- Post processing helpers

Localization parameters

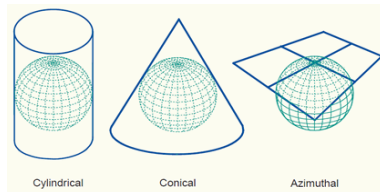
Selecting a region of the Earth surface

- Projection
- Region center lat/lon coordinates
- Integration domain horizontal resolution
- Number of points defines domain extent



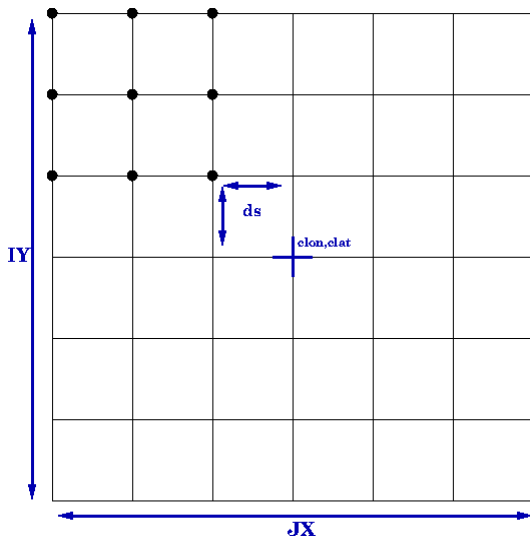
Projections

Supported Projections

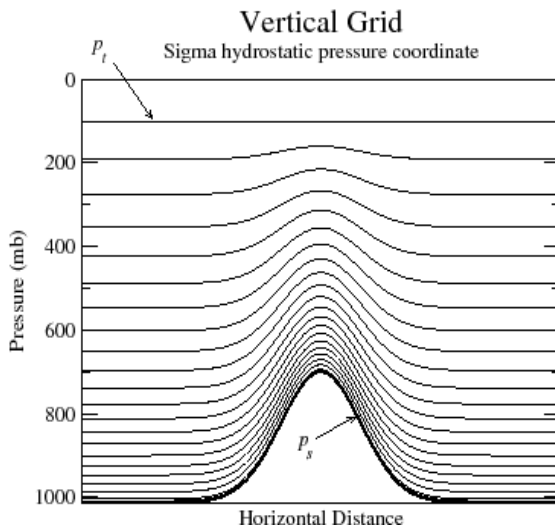


- Lambert Conformal Conical
- Mercator Cylindrical
- Rotated Mercator Cylindrical
- Polar Stereographic Azimuthal

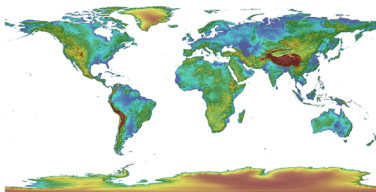
Horizontal Grid



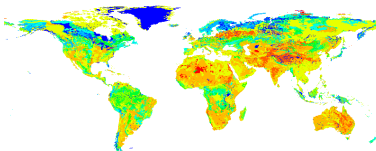
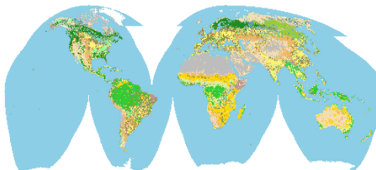
Vertical Grid



Topography, Landuse and Texture



- GMTED
- GLCC
- ZOBLER



Initial and Boundary Conditions

Horizontal and Vertical interpolation on model grid of data from

- Reanalysis
- GCM simulations

Required variables:

- SST 2D data
- U , V , T and Q 3D data



Supported Reanalyses



- ECMWF ERAIN
- NCEP-DOE NNRP
- JRA55

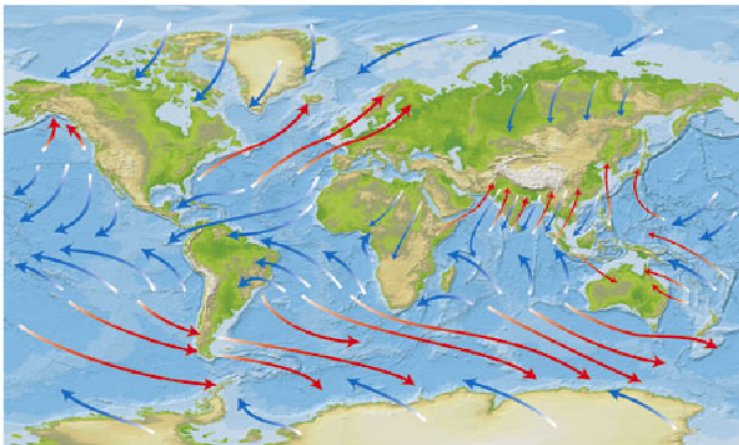
Supported CMIP5 GCMs

<http://clima-dods.ictp.it/regcm4>



- CNRM-CM5
- CSIRO-MK36
- CanESM2
- EC-EARTH
- GFDL-ESM2
- HadGEM2
- IPSL-CM5A-LR
- MPI-EMS-MR

Atmospheric motion



Dynamical cores

Two finite differences explicit solvers

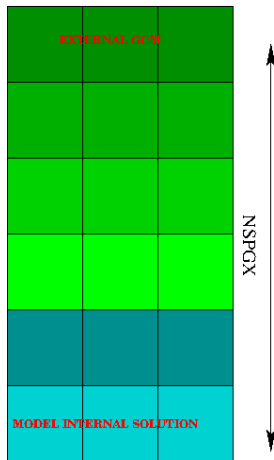
- Hydrostatic MM4 core

$$\frac{\partial p}{\partial z} = -\rho g$$

- Non-hydrostatic MM5 core

$$\frac{\partial w}{\partial t} = - \left(\mathbf{u} \cdot \frac{\partial \mathbf{w}}{\partial \mathbf{x}} \right) - \frac{1}{\rho_0} \frac{\partial p'}{\partial z} + gB - gq$$

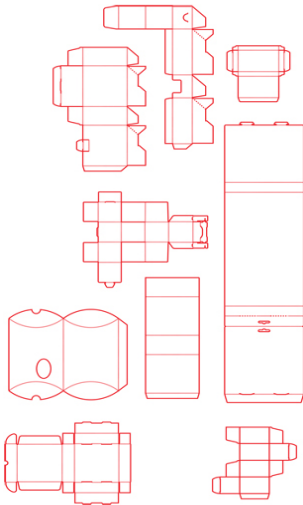
Boundary condition nudging



- Exponential relaxation boundary

$$F(n) = \exp \left[\frac{(n-2)}{N} \right]$$

Physical Packages



- Cumulus convection
- Boundary Layer
- Microphysics
- Surface (land and ocean)
- Radiation
- Aerosol and chemistry

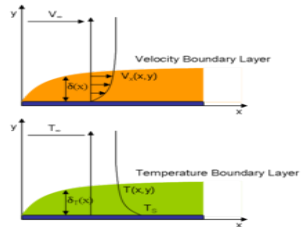
Cumulus Options

- Kuo
- Grell
- Betts-Miller
- MIT - Emanuel
- Tiedtke - 4 options
- Kain - Fritsch

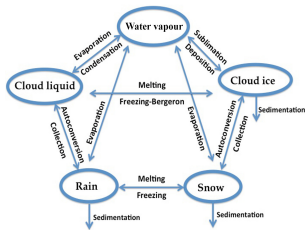


PBL Options

- Holtslag
 - Large scale eddies
- UW Bretherton
 - TKE 1.5 order local closure
 - TKE prognostic equations

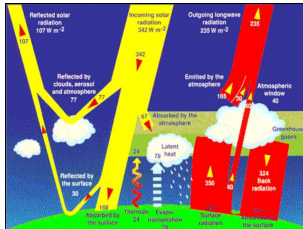


Microphysic Options



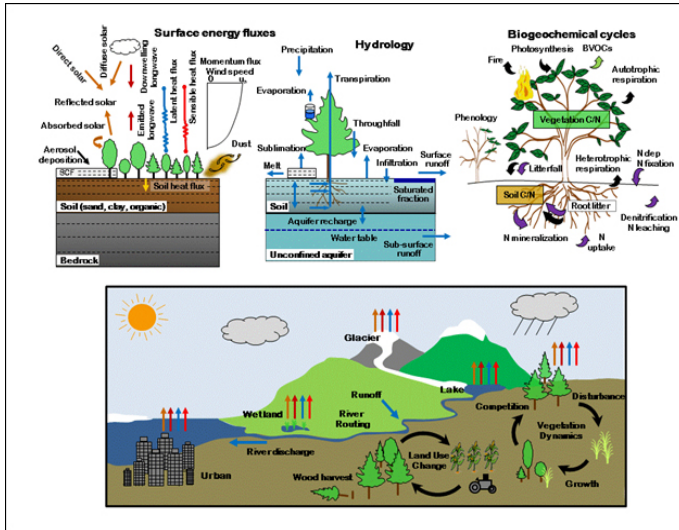
- SUBEX
 - Warm rain
- Nogherotto - Tompkins
- WRF Simple Microphysics 5
 - Ice , Cloud, Snow, Rain
 - full prognostic variables

Radiation Options

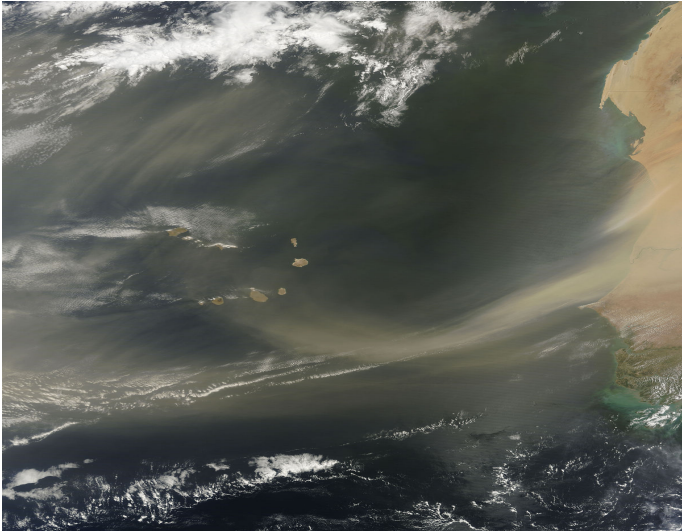


- CCSM
 - Simple clouds
- RRTM
 - Randomized cloud fractional coverage

Surface Model - Internal coupling

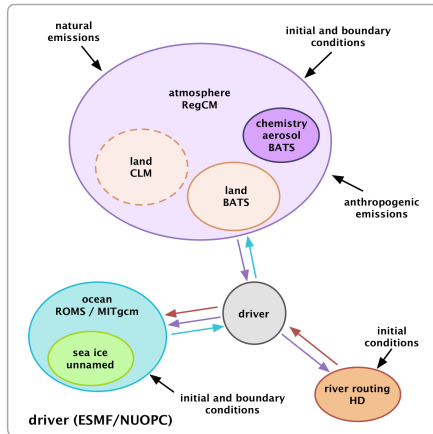


Tracer transport and full online chemistry

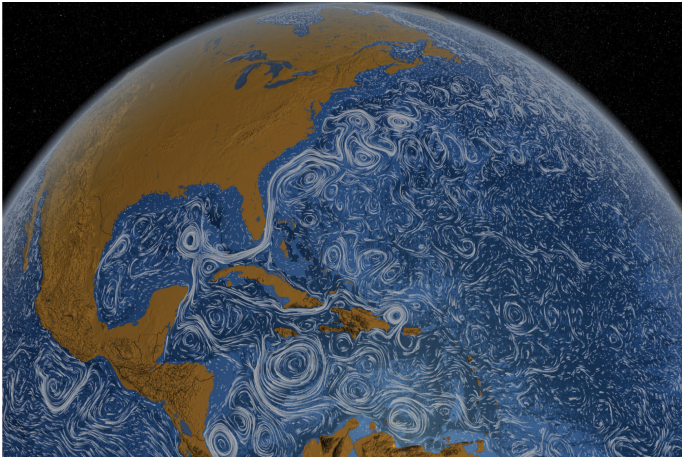


RegSM

The RegCM is the atmospheric component of the RegESM model



External coupling - OCEAN



External coupling - WAM



External coupling - Hydrological Discharge



Model Output



- ATM atmospheric condition
- SRF surface variables
- RAD radiation package
- STS statistics over 24Hr
- CHE, OPT, SUB, LAK