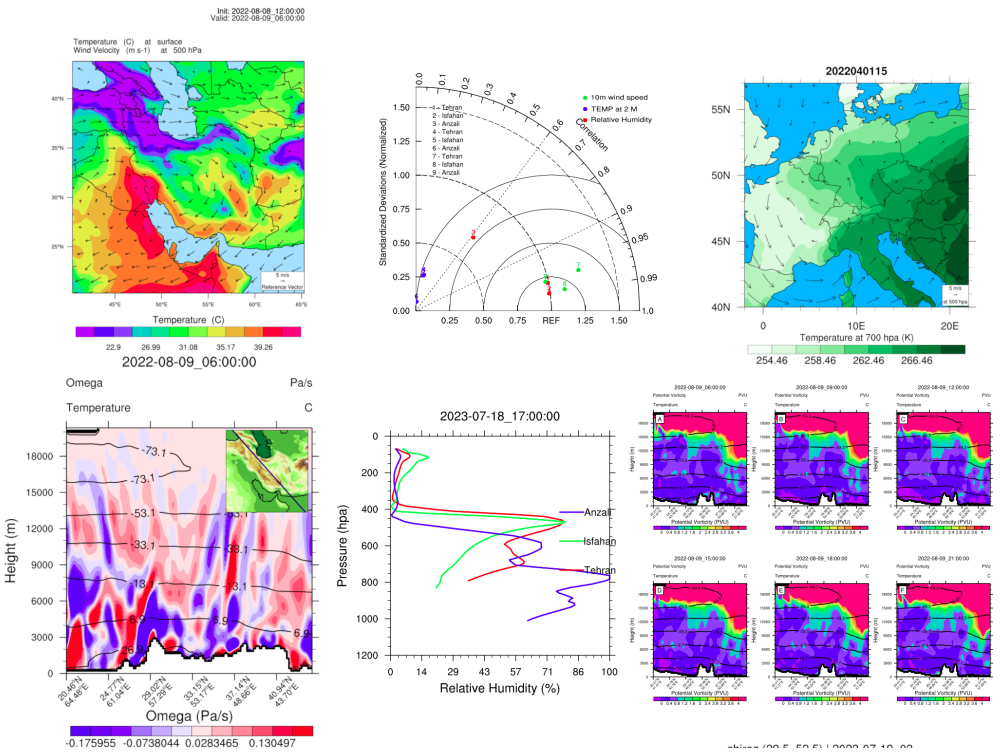
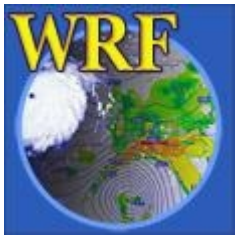
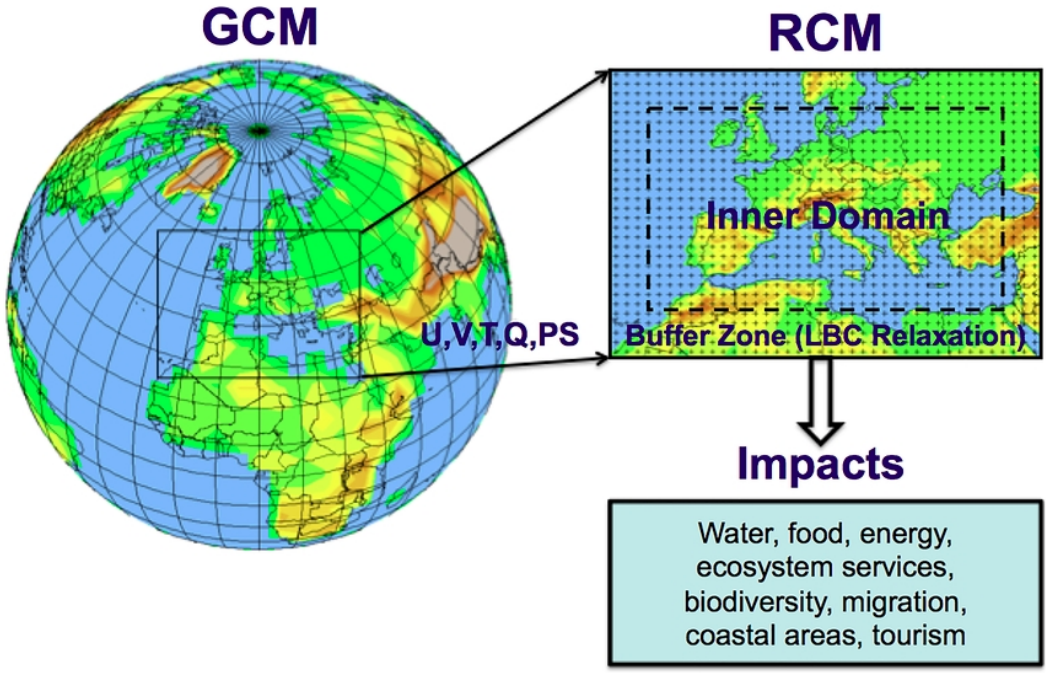
PostWRF:
Visualization of the WRF and ERA5 data

Amir H. Nikfal

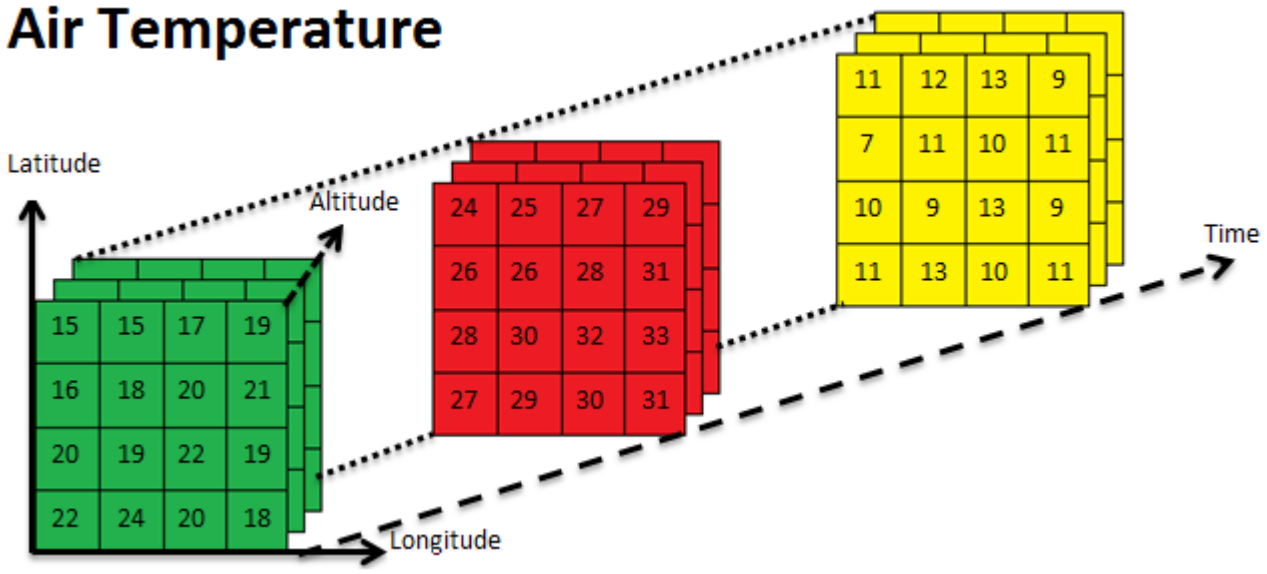


PostWRF software:
Visualization of WRF model



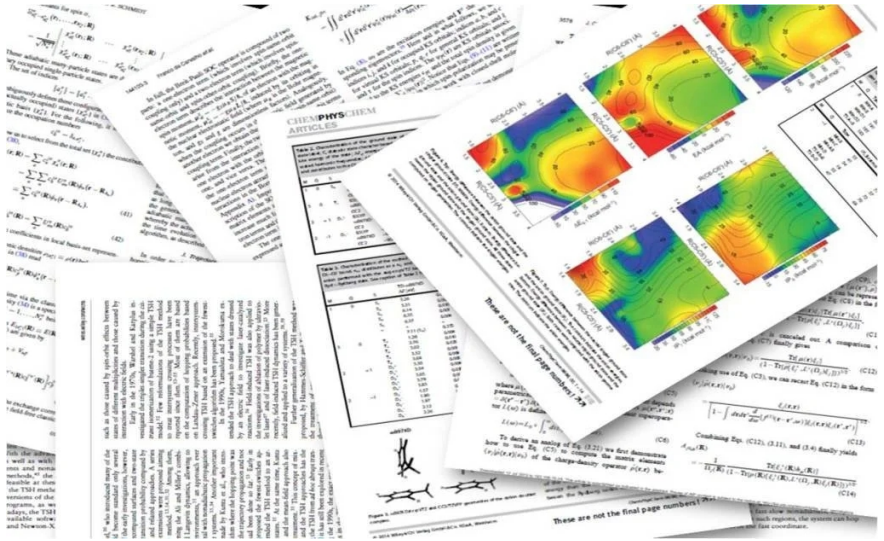


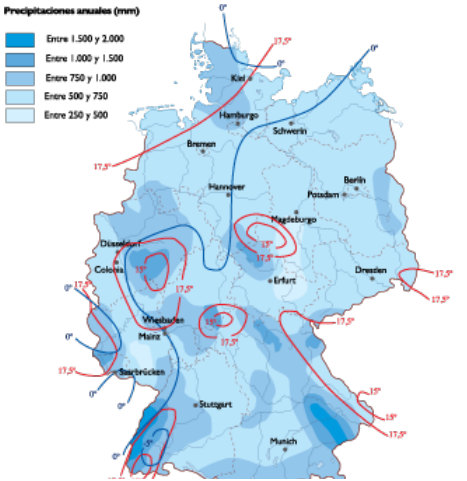
PostWRF software:
Data format

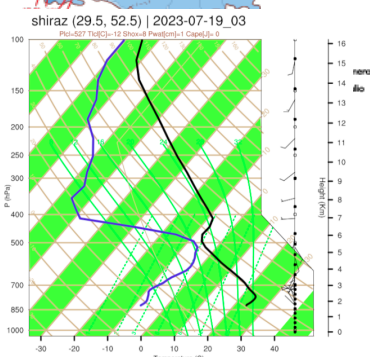


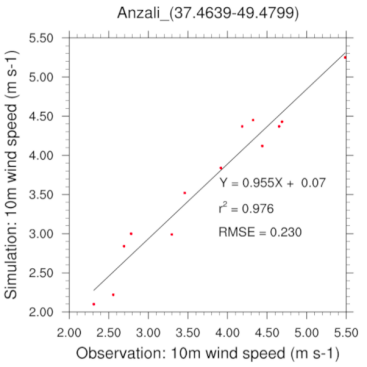
Purpose of the software

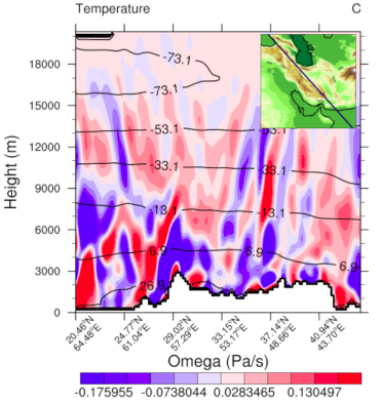
Scientific papers in meteorology





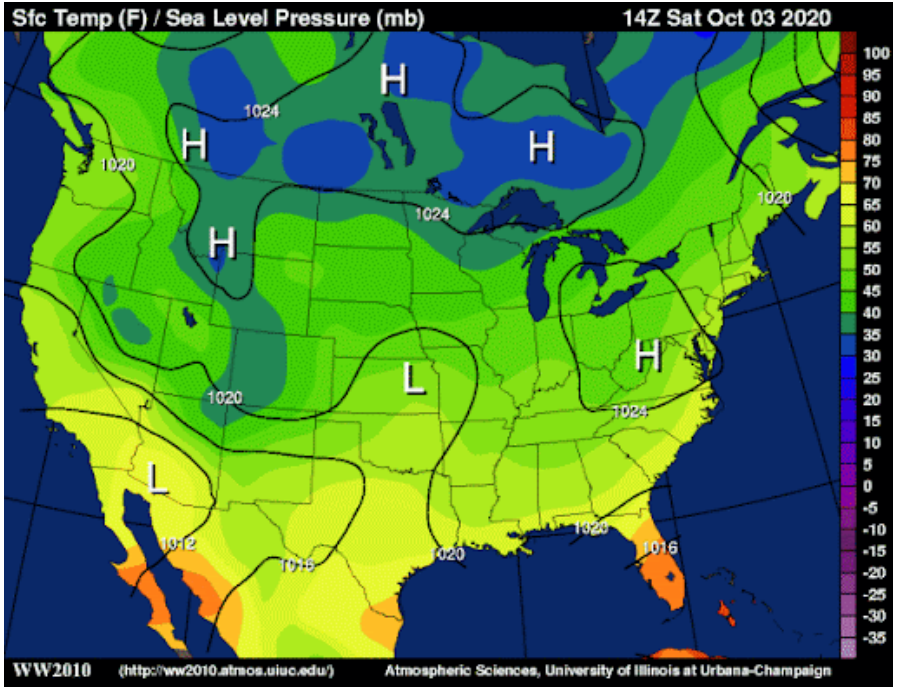






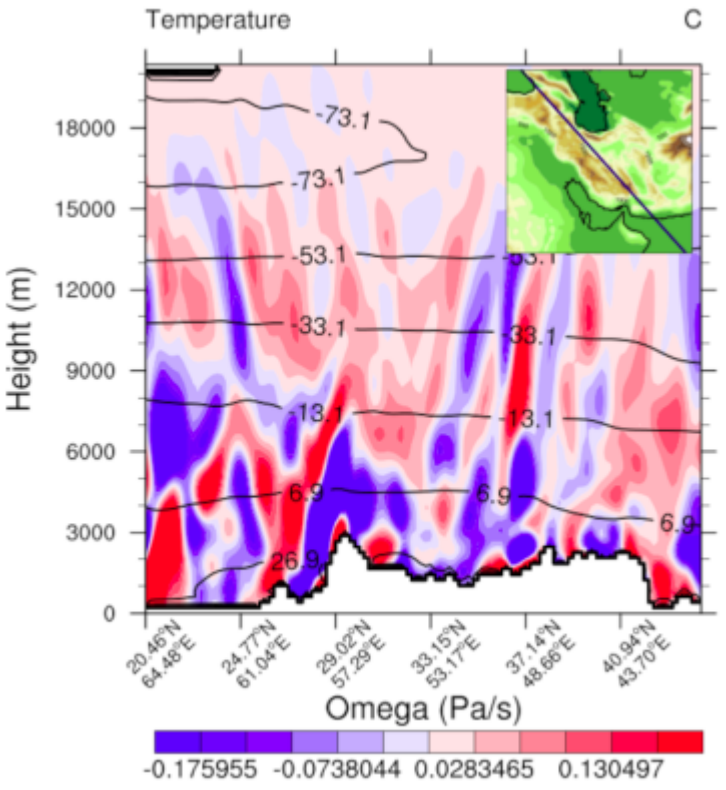
Most frequently used visualizations

Contour plot



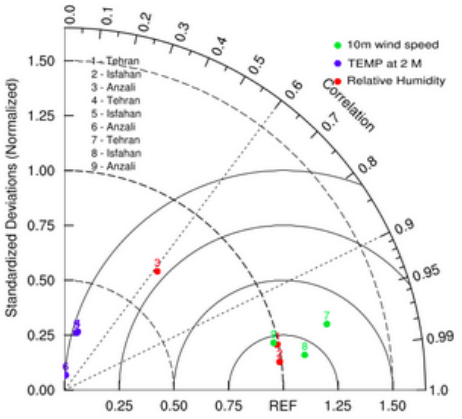
Most frequently used visualizations

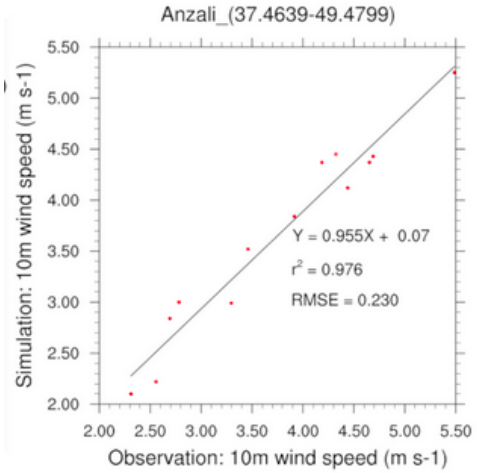
Cross-section plot

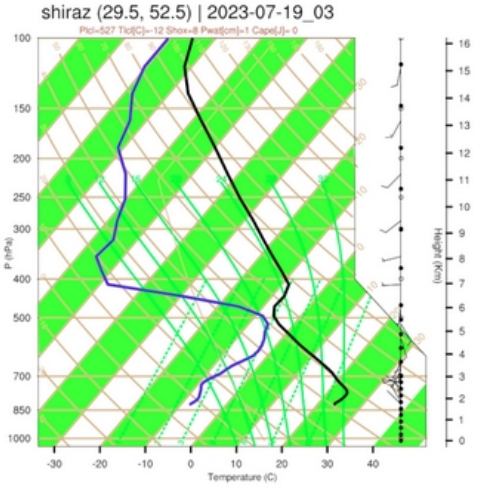


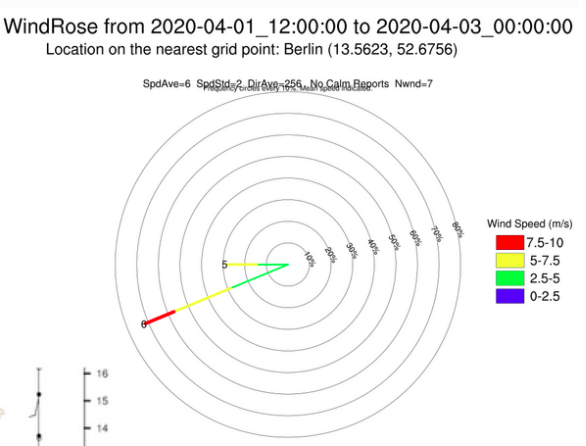
Most frequently used visualizations

Met diagrams





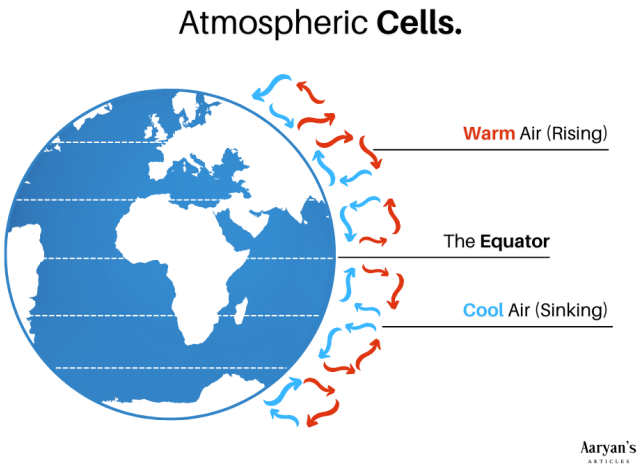




Running PostWRF is simple

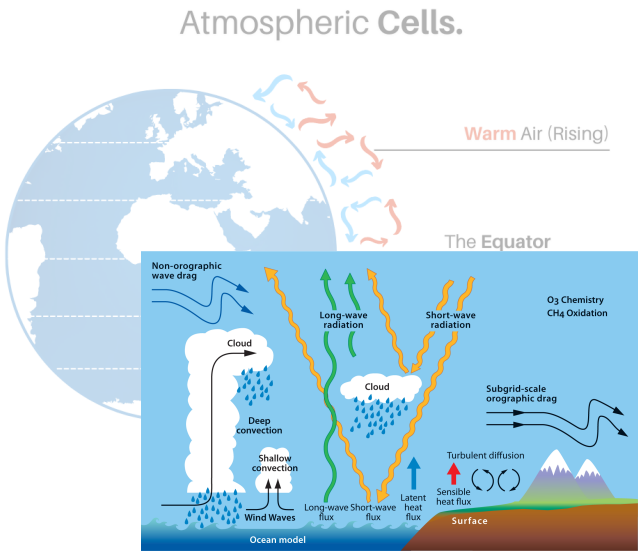
Running PostWRF  **Running WRF**

How WRF is run?



Atmospheric Dynamics

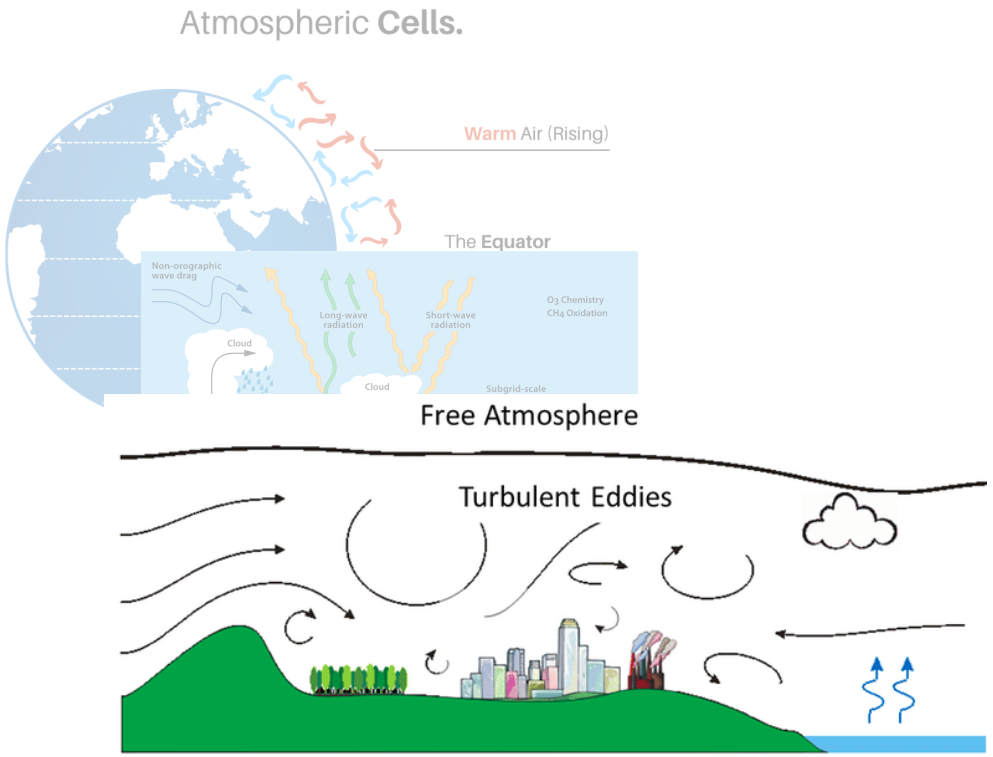
How WRF is run?



Atmospheric Dynamics

Physics/micro-physics

How WRF is run?

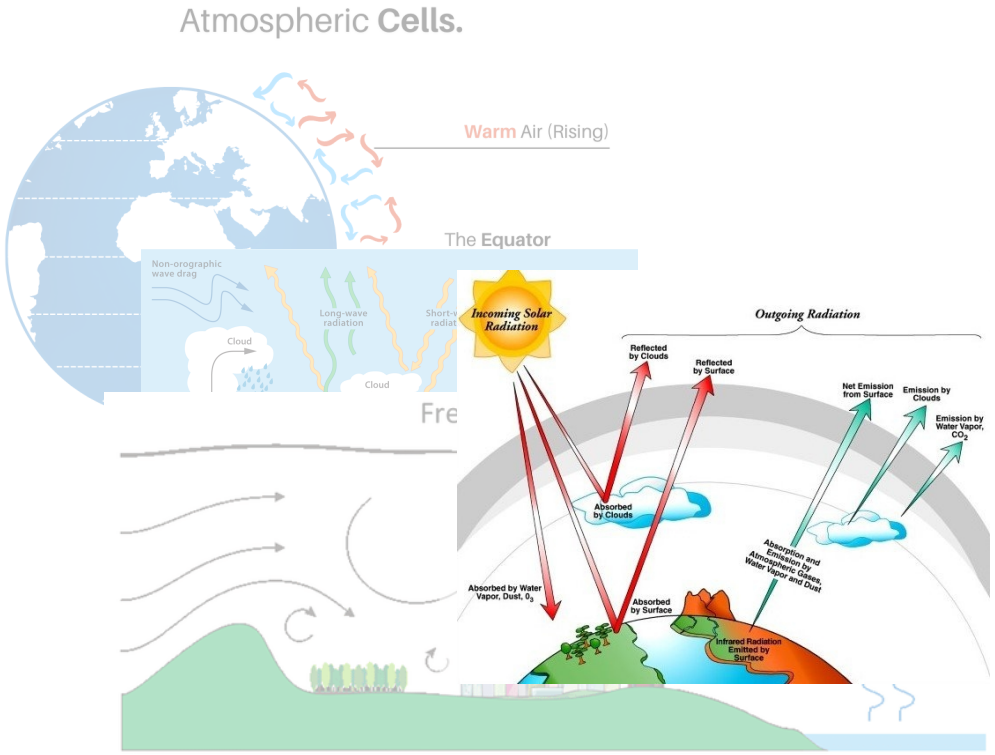


Atmospheric Dynamics

Physics/micro-physics

Boundary layer Physics

How WRF is run?

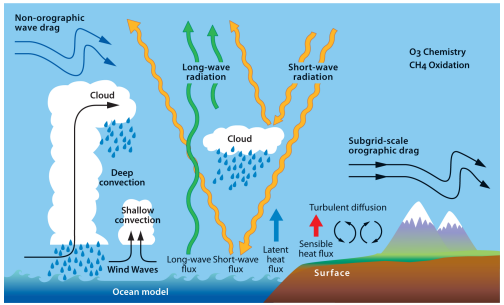


Atmospheric Dynamics

Physics/micro-physics

Boundary layer Physics

Atmospheric Radiation



WRF is run by a namelist

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progn                       = 0,    0,
ra_lw_physics               = 1,    1,    1,
ra_sw_physics               = 2,    2,    1,
radt                        = 30,   30,   30,
sf_sfclay_physics           = 1,    1,    1,
sf_surface_physics          = 2,    2,    1,
bl_pbl_physics              = 1,    1,    1,
```

1. Microphysics (mp_physics)

a. Kessler scheme: A warm-rain (i.e. no ice) scheme used commonly in idealized cloud modeling studies (*mp_physics* = 1).

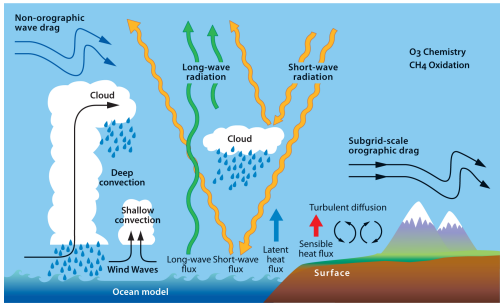
b. Lin et al. scheme: A sophisticated scheme that has ice, snow and graupel processes, suitable for real-data high-resolution simulations (2).

c. WRF Single-Moment 3-class scheme: A simple, efficient scheme with ice and snow processes suitable for mesoscale grid sizes (3).

d. WRF Single-Moment 5-class scheme: A slightly more sophisticated version of (c) that allows for mixed-phase processes and super-cooled water (4).

e. Eta microphysics: The operational microphysics in NCEP models. A simple efficient scheme with diagnostic mixed-phase processes. For fine resolutions (< 5km) use option (5) and for coarse resolutions use option (95).

f. WRF Single-Moment 6-class scheme: A scheme with ice, snow and graupel processes suitable for high-resolution simulations (6).



WRF is run by a namelist

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&physics
mp_physics                  = 4,    2,    2,
progn                       = 0,    0,
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ra_sw_physics               = 2,    2,    1,
radt                        = 30,   30,   30,
sf_sfclay_physics           = 1,    1,    1,
sf_surface_physics          = 2,    2,    1,
bl_pbl_physics              = 1,    1,    1,
```

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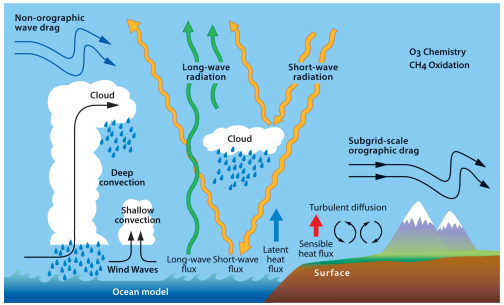

WRF is run by a namelist

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&physics
mp_physics                  = 4,    2,    2,
progn                       = 0,    0,
ra_lw_physics               = 1,    1,    1,
ra_sw_physics               = 2,    2,    1,
radt                        = 30,   30,   30,
sf_sfclay_physics           = 1,    1,    1,
sf_surface_physics          = 2,    2,    1,
bl_pbl_physics              = 1,    1,    1,
```

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f. WRF Single-Moment 6-class scheme: A scheme with ice, snow and graupel processes suitable for high-resolution simulations (6).

PostWRF's run process

namelist

WRF_Extract_ON_OFF = 0

…

…

…

CONTOUR_ON_OFF = 0

…

…

…

CROSSSECTION_ON-OFF = 0

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STATISTICAL_DIAGRAMS_ON_OFF = 0

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…

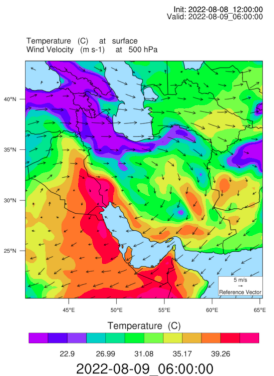
…

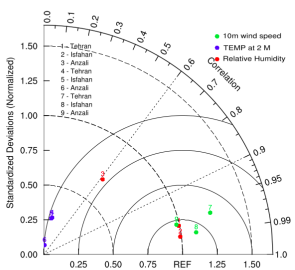
Domain_On-Off = 0

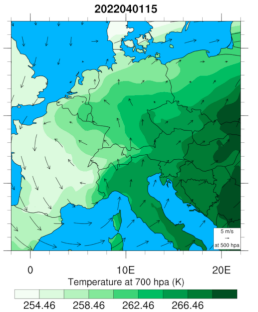
…

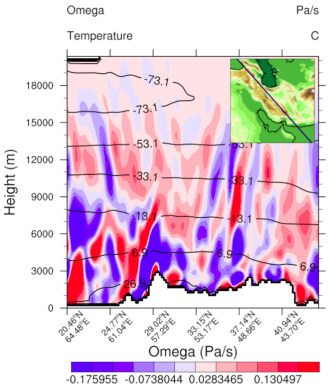
…

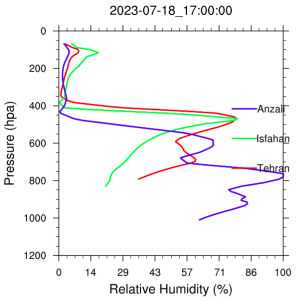
…

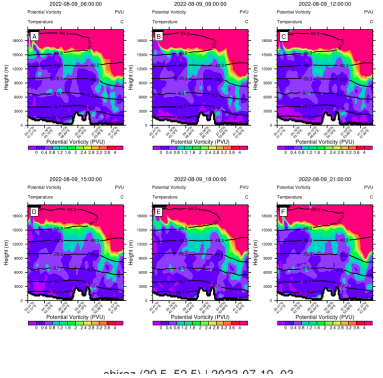












PostWRF's run process

namelist

WRF_Extract_ON_OFF = 0

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CONTOUR_ON_OFF = 1

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CROSSSECTION_ON-OFF = 0

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STATISTICAL_DIAGRAMS_ON_OFF = 0

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Domain_On-Off = 0

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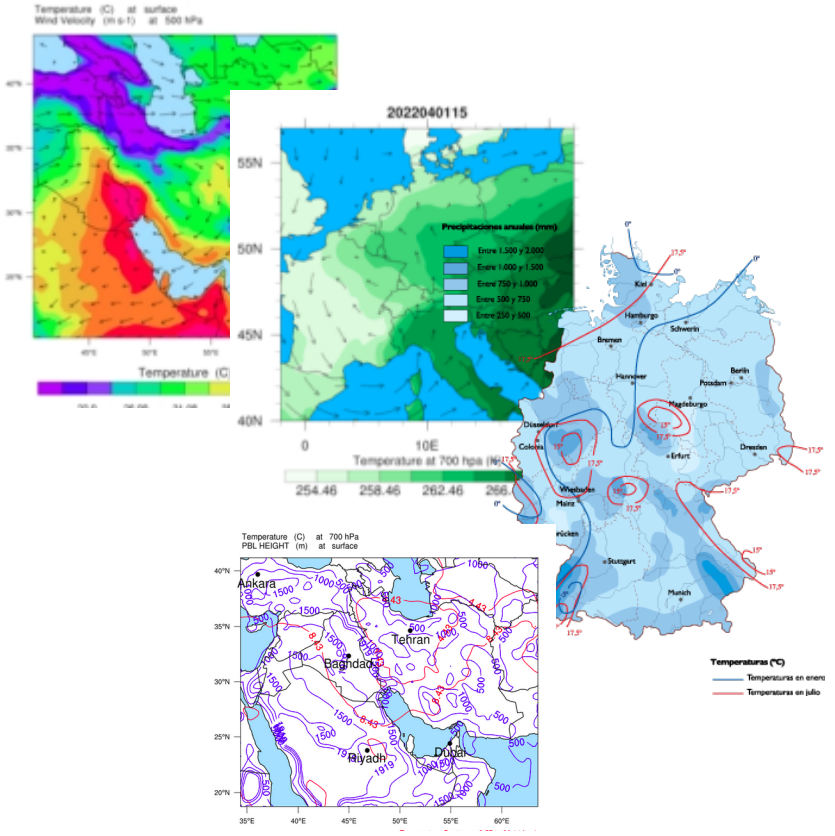

namelist PostWRF's run process

CONTOUR_ON_OFF = 1

!!! Variable_1 by line contours !!!
1st_Variable_on_off = 1
1st_Variable_name = tc
1st_Variable_pressure_level = 700
1st_Variable_intervals = 5
1st_Variable_line_color = red
1st_Variable_line_thickness = 0.5
1st_Variable_label_size = 0.5

!!! Variable_2 by (broken) line contours !!!
2nd_Variable_on_off = 0
2nd_Variable_name = pvo
2nd_Variable_pressure_level = 700
2nd_Variable_intervals = 0
2nd_Variable_line_color = red
2nd_Variable_line_thickness = 0.5
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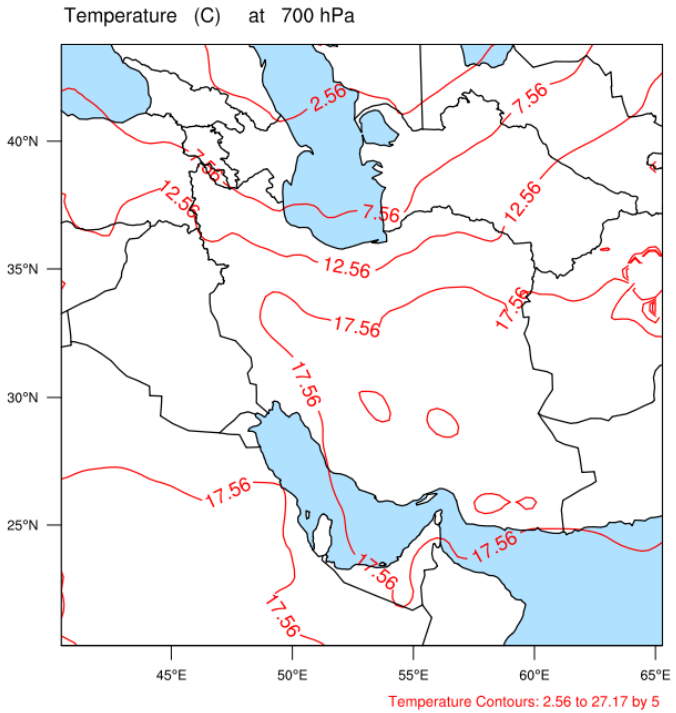
2nd_Variable_brokenline_on_off = 1

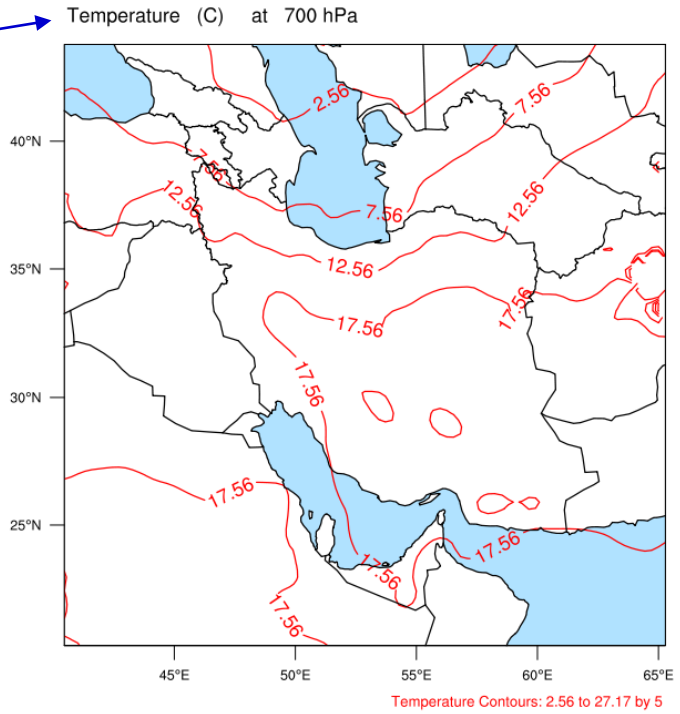
!!! Variable_3 by shaded contours !!!
3rd_Variable_on_off = 0
3rd_Variable_name = rh



namelist PostWRF's run process

CONTOUR_ON_OFF = 1

!!! Variable_1 by line contours !!!
1st_Variable_on_off = 1
1st_Variable_name = tc
1st_Variable_pressure_level = 700
1st_Variable_intervals = 5
1st_Variable_line_color = red
1st_Variable_line_thickness = 0.5
1st_Variable_label_size = 0.5



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2nd_Variable_on_off = 0
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2nd_Variable_intervals = 0
2nd_Variable_line_color = red
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3rd_Variable_name = rh

namelist PostWRF's run process

CONTOUR_ON_OFF = 1

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1st_Variable_on_off = 1
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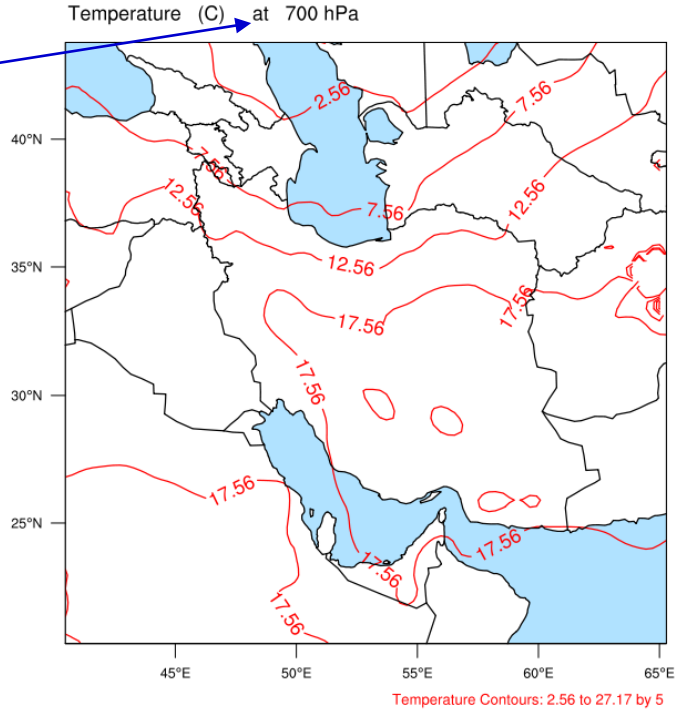

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2nd_Variable_on_off = 0
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1st_Variable_name = tc
1st_Variable_pressure_level = 700
1st_Variable_intervals = 5
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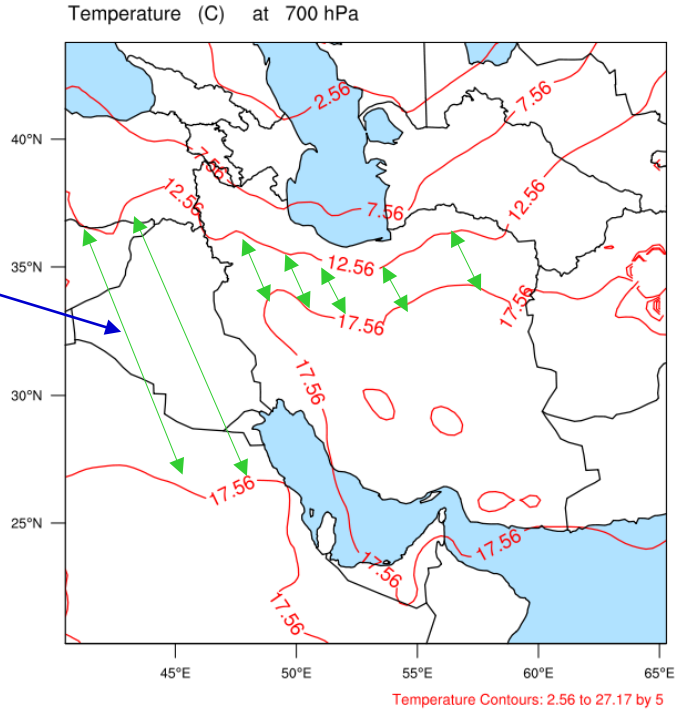

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2nd_Variable_on_off = 0
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2nd_Variable_pressure_level = 700
2nd_Variable_intervals = 0
2nd_Variable_line_color = red
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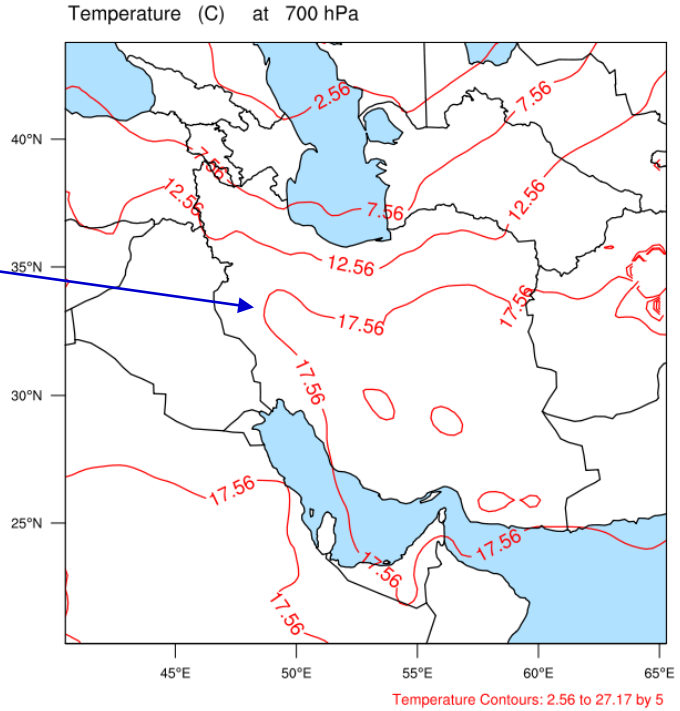
1st_Variable_intervals = 5
1st_Variable_line_color = red
1st_Variable_line_thickness = 0.5
1st_Variable_label_size = 0.5



!!! Variable_2 by (broken) line contours !!!
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2nd_Variable_pressure_level = 700
2nd_Variable_intervals = 0
2nd_Variable_line_color = red
2nd_Variable_line_thickness = 0.5
2nd_Variable_label_size = 0.4
2nd_Variable_brokenline_on_off = 1

!!! Variable_3 by shaded contours !!!
3rd_Variable_on_off = 0
3rd_Variable_name = rh

namelist PostWRF's run process

CONTOUR_ON_OFF = 1

!!! Variable_1 by line contours !!!
1st_Variable_on_off = 1
1st_Variable_name = tc
1st_Variable_pressure_level = 700
1st_Variable_intervals = 5
1st_Variable_line_color = red
1st_Variable_line_thickness = 0.5
1st_Variable_label_size = 0.5

!!! Variable_2 by (broken) line contours !!!
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2nd_Variable_line_color = green
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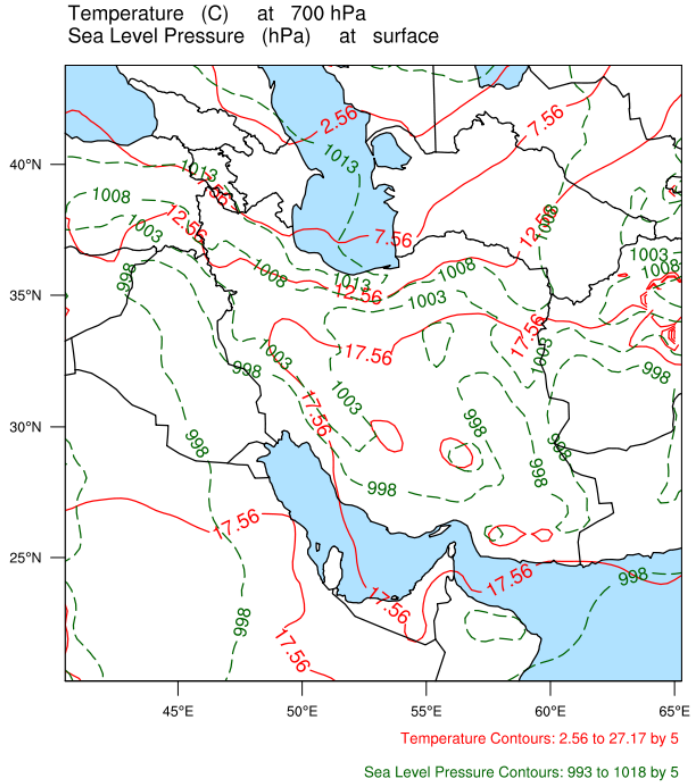
!!! Variable_3 by shaded contours !!!
3rd_Variable_on_off = 0
3rd_Variable_name = rh



namelist PostWRF's run process

CONTOUR_ON_OFF = 1

!!! Variable_1 by line contours !!!
1st_Variable_on_off = 1
1st_Variable_name = tc
1st_Variable_pressure_level = 700
1st_Variable_intervals = 5
1st_Variable_line_color = red
1st_Variable_line_thickness = 0.5
1st_Variable_label_size = 0.5

!!! Variable_2 by (broken) line contours !!!
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2nd_Variable_line_color = green
2nd_Variable_line_thickness = 0.5
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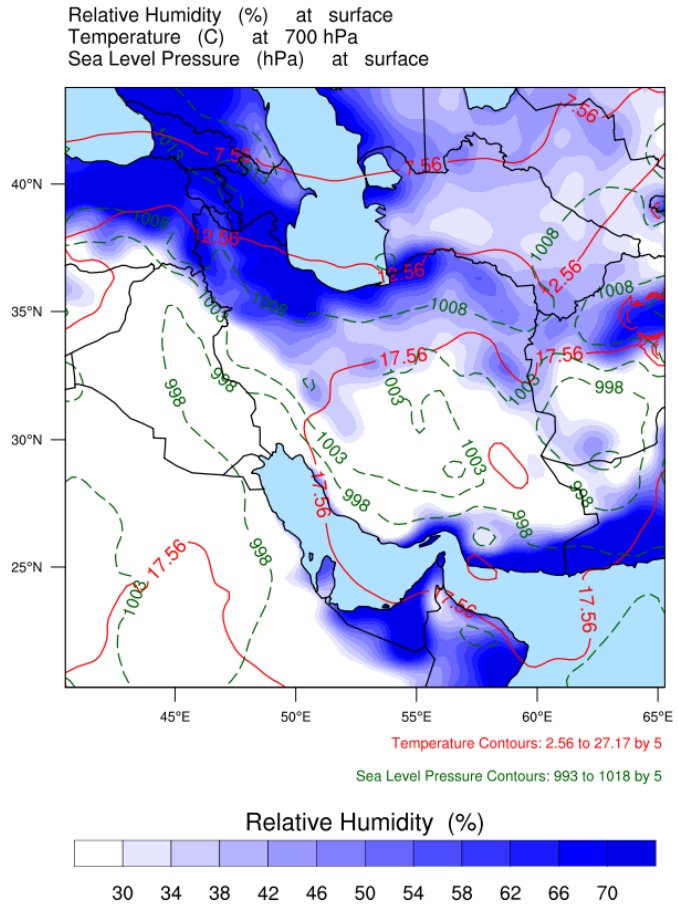
2nd_Variable_brokenline_on_off = 1

!!! Variable_3 by shaded contours !!!
3rd_Variable_on_off = 1
3rd_Variable_name = rh



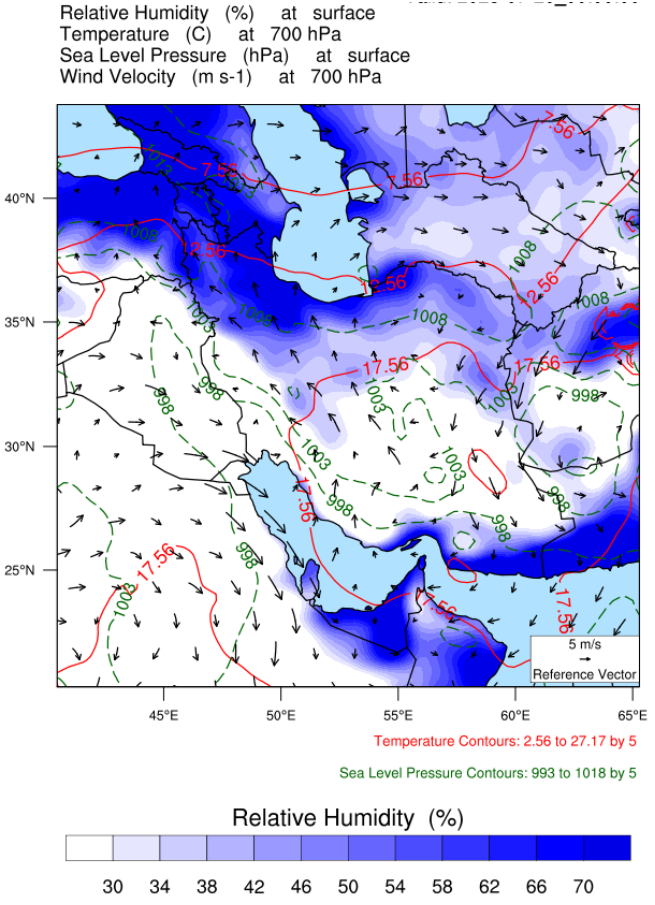
namelist PostWRF's run process

CONTOUR_ON_OFF = 1

!!! Variable_1 by line contours !!!
1st_Variable_on_off = 1
1st_Variable_name = tc
1st_Variable_pressure_level = 700
...
…
…
…
...

Wind_Vectors_on_off = 1
Wind_Vectors_pressure_level = 700
Wind_Vectors_speed (m/s) = 5
Wind_Vectors_density = 0.5
Wind_Vectors_color = black
Wind_Vectors_thickness = 0.5

Location_point_mark_on_off = 0
Location_labels_on_off = 1
Location_labels_size = 0.2
Location_labels_color = black
Shapefile_on-off = 0
Shapefile_path = ~/state.shp



PostWRF: Visualization of WRF model

Fully documented:
https://postwrf.readthedocs.io

YouTube training videos

Contents lists available at ScienceDirect

Environmental Modelling and Software

journal homepage: www.elsevier.com/locate/envsoft

PostWRF: Interactive tools for the visualization of the WRF and ERA5 model outputs

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ABSTRACT

PostWRF is an open-source software toolkit to facilitate the main visualization tasks and data handling for the WRF model outputs. The toolkit is mostly written in NCL and Shell, with a namelist that resembles the WRF or WPS namelists. Besides the visualizations, PostWRF provides WRF-NetCDF to GeoTIFF conversion for GIS applications, ERA5-NetCDF reanalysis data plotting and extraction, and preparation and plotting of the RTTOV model inputs (from WRF) and outputs. The primary purpose of PostWRF is to benefit the environmental researchers (both experienced and inexperienced) to make use of the WRF model simulations, in a straightforward and efficient way, without dealing with coding and syntax errors. Since the WRF model simulates most aspects of a full atmospheric model in the regional scale, the toolkit can also be used as an educational aid in meteorological and environmental science. PostWRF is freely available on GitHub (https://github.com/anikfal/PostWRF), provided with HTML documentations (https://postwrf.readthedocs.io/en/master) and guided examples.