

WRF Tracer Forecast

Model Version: WRF V3.3.1 with inert tracers

Setup: 2-domains, “East Asia” (15 x 15 km²) and “Korea” (3 x 3 km²)

Meteorology: GFS 0.5 deg forecasts

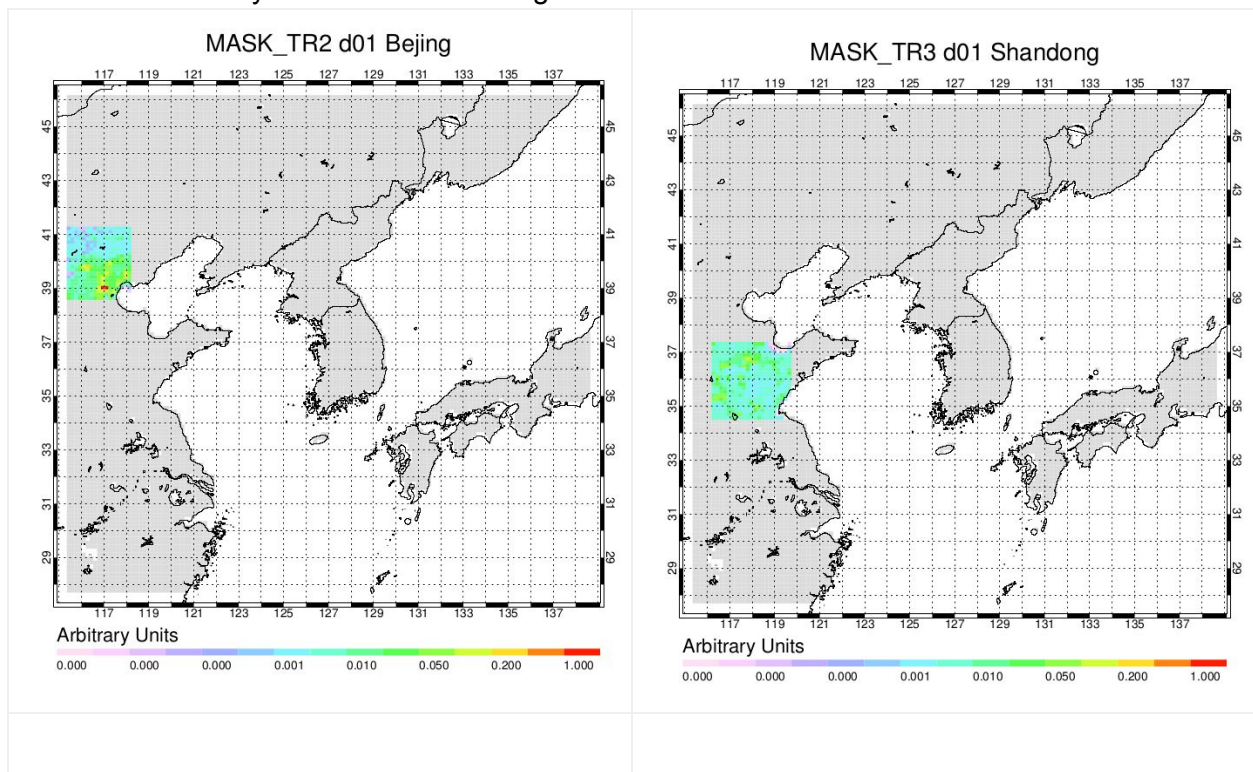
Forecast Cycles: every 00 UTC, out to 72 hours

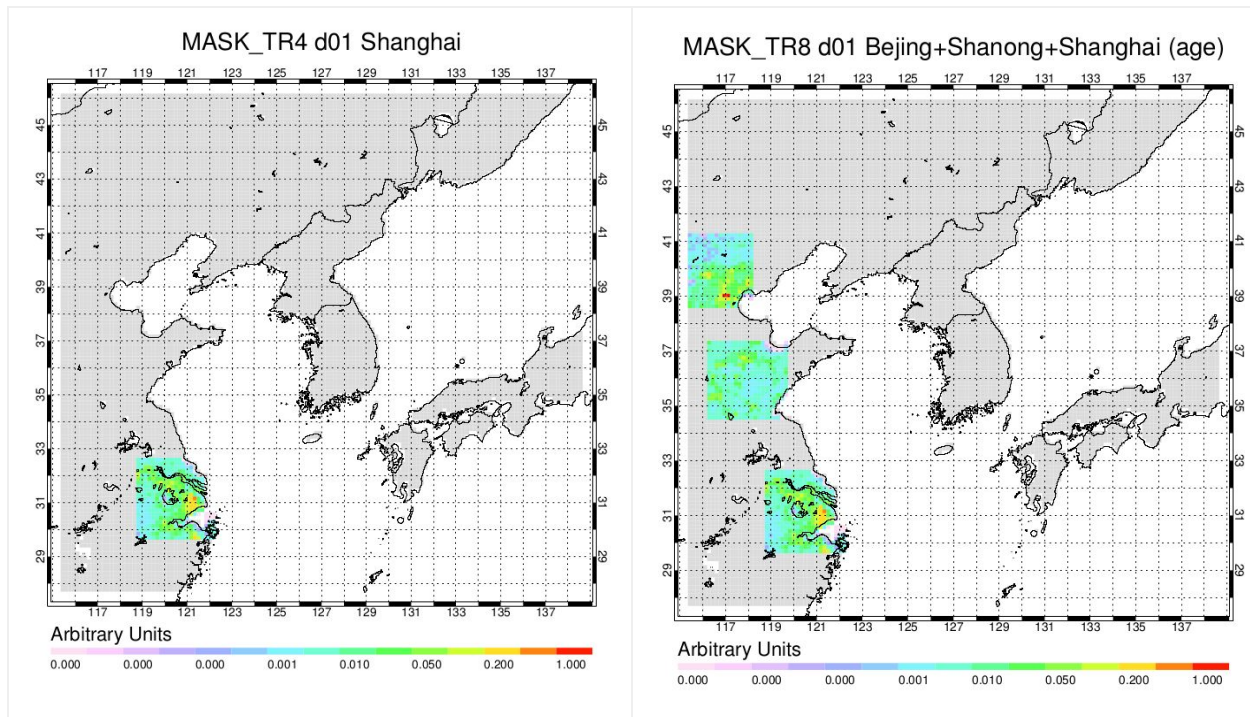
Tracers in “East Asia” domain:

- TR2: Beijing (+/- 10 grids surrounding 39.9N and 116.41E)
- TR3: Shandong (+/- 10 grids surrounding 36.0N, 118E)
- TR4: Shanghai (+/- 10 grids surrounding 31.23N and 120.5E)
- TR8: Beijing+Shandong+Shanghai

Emissions are based on 0.1 deg inventory for May and scaled to NO₂

TR2-4 have a 4-day lifetime. TR8 is an age tracer and has infinite lifetime



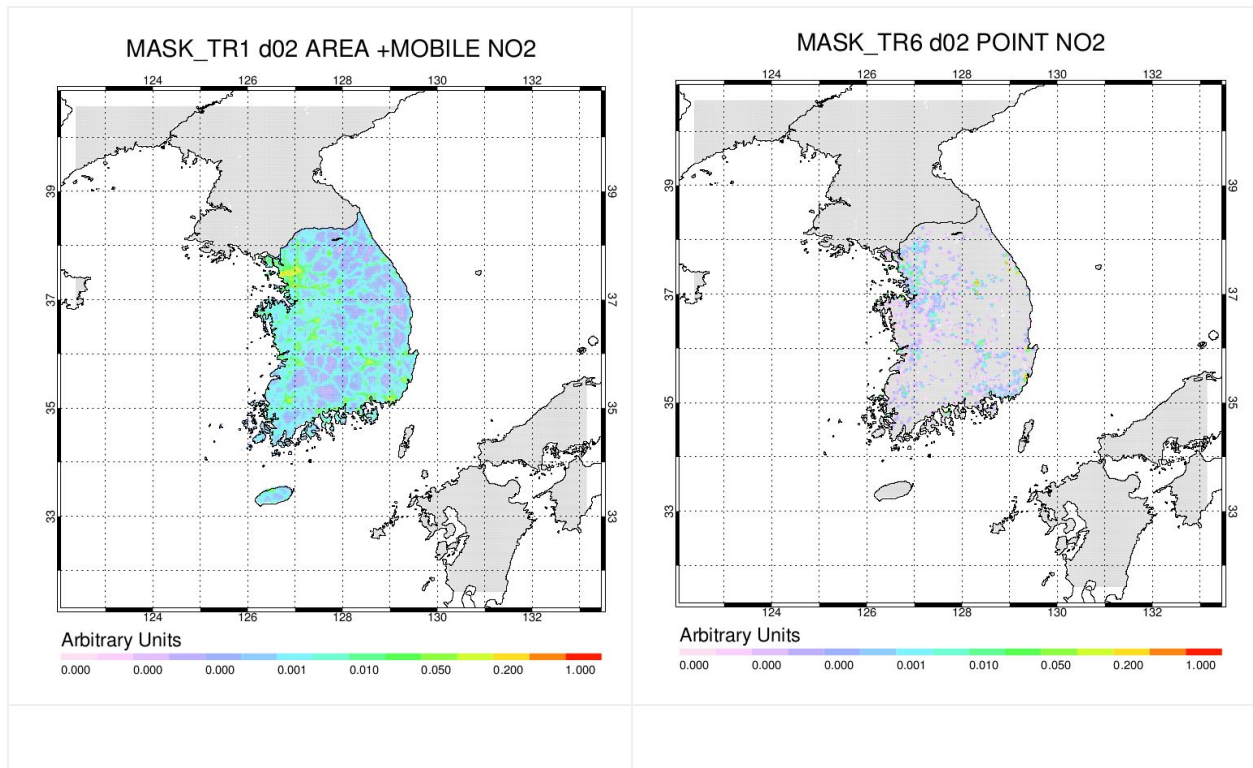


Tracers in “Korea” domain 3km Korean Inventory

- TR1 Area and Mobile Sources
- TR6 Point Sources
- TR7 Area and Mobile sources (same as TR1)

Emissions are based on the 3km inventory for May and scaled to NO₂

TR1 and TR6 have a 2-day lifetime. TR7 is an age tracer and has infinite lifetime



Notes:

All emission tracers are scaled to NO2 emissions (normalized by 10.5) and then corrected for the different grid size between 3km and 0.1 deg inventories

Point sources are added to vertical model level 5, all other emissions are released at the surface

Emissions do not have a diurnal cycle

Hourly Model Output for both domains is available

OTHER TRACERS (not plotted)

Lightning tracer, Stratospheric Tracer and Lateral Boundary Conditions Tracer

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WRF namelist

```
&time_control
run_days           = 0,
run_hours          = 24,
run_minutes        = 0,
run_seconds        = 0,
start_year         = 2016,2016,
start_month        = 04,04,
start_day          = 13,13,
start_hour         = 00,00,
start_minute       = 00, 00, 00, 00, 00, 00,
start_second       = 00, 00, 00, 00, 00, 00,
end_year           = 2016,2016,
end_month          = 04,04,
end_day            = 14,14,
end_hour           = 00,00,
end_minute         = 00, 00, 5, 5, 5, 5,
end_second         = 00, 00, 00, 00, 00, 00,
interval_seconds   = 21600,
input_from_file    = .true.,.true.,.true., .true., .true., .true.,
history_interval   = 60,60,60,60,60,60,
frames_per_outfile = 1, 1, 1, 1, 1, 1,
restart            = .false.,
restart_interval   = 25000,
auxinput11_interval = 1, 1,
auxinput11_end_h   = 99999,99999,
io_form_history    = 2,
io_form_restart    = 2,
io_form_input      = 2,
io_form_boundary   = 2,
auxinput1_inname   = "met_em.d<domain>.<date>"
auxinput13_inname  = "wrfraci_d<domain>",
auxinput13_interval_h = 3000,3000,
frames_per_auxinput13 = 1,1,
io_form_auxinput13 = 2,
lght_tracer_start_time = 1800,1800,
lght_tracer_interval = 60,60,
debug_level        = 0,
iofields_filename  = "hist_io_mods_d01","hist_io_mods_d02",
bdy_inname         = "wrfbdy_d<domain>_<date>",
/
&domains
time_step          = 60,
time_step_fract_num = 0,
time_step_fract_den = 1,
max_dom            = 2,
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e_we          = 140, 321,
e_sn          = 140, 331,
s_vert       = 1, 1,
e_vert       = 37, 37,
dx           = 15000.0000, 3000.0000,
dy           = 15000.0000, 3000.0000,
grid_id      = 1, 2, 3, 4, 5, 6,
parent_id    = 0, 1, 2, 2, 3, 2,
i_parent_start = 1, 43,
j_parent_start = 1, 28,
parent_grid_ratio = 1, 5,
parent_time_step_ratio = 1, 5,
feedback     = 0,
smooth_option = 0,
num_metgrid_levels = 27,
interp_type  = 1,
lagrange_order = 1,
zap_close_levels = 500,
lowest_lev_from_sfc = .false.,
force_sfc_in_vinterp = 1,
p_top_requested = 1000,
extrap_type  = 2,
t_extrap_type = 2,
use_levels_below_ground = .true.,
use_surface  = .true.,
sfcpl_to_sfcpl = .true.,
adjust_heights = .false.,
eta_levels   = 1.000000, 0.996200, 0.989737, 0.982460, 0.974381,
              0.965422, 0.955498, 0.944507, 0.932347, 0.918907,
              0.904075, 0.887721, 0.869715, 0.849928, 0.828211,
              0.804436, 0.778472, 0.750192, 0.719474, 0.686214,
              0.650339, 0.611803, 0.570656, 0.526958, 0.480854,
              0.432582, 0.382474, 0.330973, 0.278674, 0.226390,
              0.175086, 0.132183, 0.096211, 0.065616, 0.039773,
              0.018113, 0.000000,
num_moves    = 0,
move_id      = 2, 2,
move_interval = 60, 120,
move_cd_x    = 1, 1,
move_cd_y    = 1, 0,
vortex_interval = 15,
max_vortex_speed = 40,
corral_dist  = 8,
num_metgrid_soil_levels = 4,
/

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&physics
num_land_cat          = 24,
mp_physics            = 8,8,
ra_lw_physics        = 4, 4,
ra_sw_physics        = 4, 4,
radt                 = 15, 3,
sf_sfclay_physics    = 1, 1,
sf_surface_physics   = 2, 2,
bl_pbl_physics       = 1, 1,
bldt                 = 0, 0,
cu_physics           = 1, 0,
cudt                 = 5, 0,
isfflx               = 1,
ifsnow               = 1,
icloud               = 1,
surface_input_source = 1,
num_soil_layers      = 4,
sf_urban_physics     = 0, 0,
mp_zero_out          = 2,
mp_zero_out_thresh   = 1.e-12,
maxiens              = 1,
maxens               = 3,
maxens2              = 3,
maxens3              = 16,
ensdim               = 144,
sst_update           = 0,
/
&dynamics
w_damping            = 1,
diff_opt             = 1,
km_opt               = 4,
diff_6th_opt         = 0, 0, 0,
diff_6th_factor      = 0.05, 0.05, 0.12
base_temp            = 290.,
damp_opt             = 1,
zdamp                = 5000., 5000., 5000.,
dampcoef             = 0.15, 0.15, 0.01,
khdif                = 0, 0, 0, 0, 0,
kvdif                = 0, 0, 0, 0, 0,
non_hydrostatic      = .true., .true.,
moist_adv_opt        = 1, 2,
scalar_adv_opt       = 2, 2,
tracer_opt           = 6, 6,
tracer_adv_opt       = 1, 1,
use_baseparam_fr_nml = .true.,
do_avgflx_em         = 1, 1,

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/
&bdy_control
spec_bdy_width      = 5,
spec_zone           = 1,
relax_zone          = 4,
specified            = .true., .false.,
nested              = .false.,.true.,
/
&namelist_quilt
nio_tasks_per_group = 0,
nio_groups = 1,
/
```