Simulation of dust emission in Gorgan Bay area in semi-arid conditions

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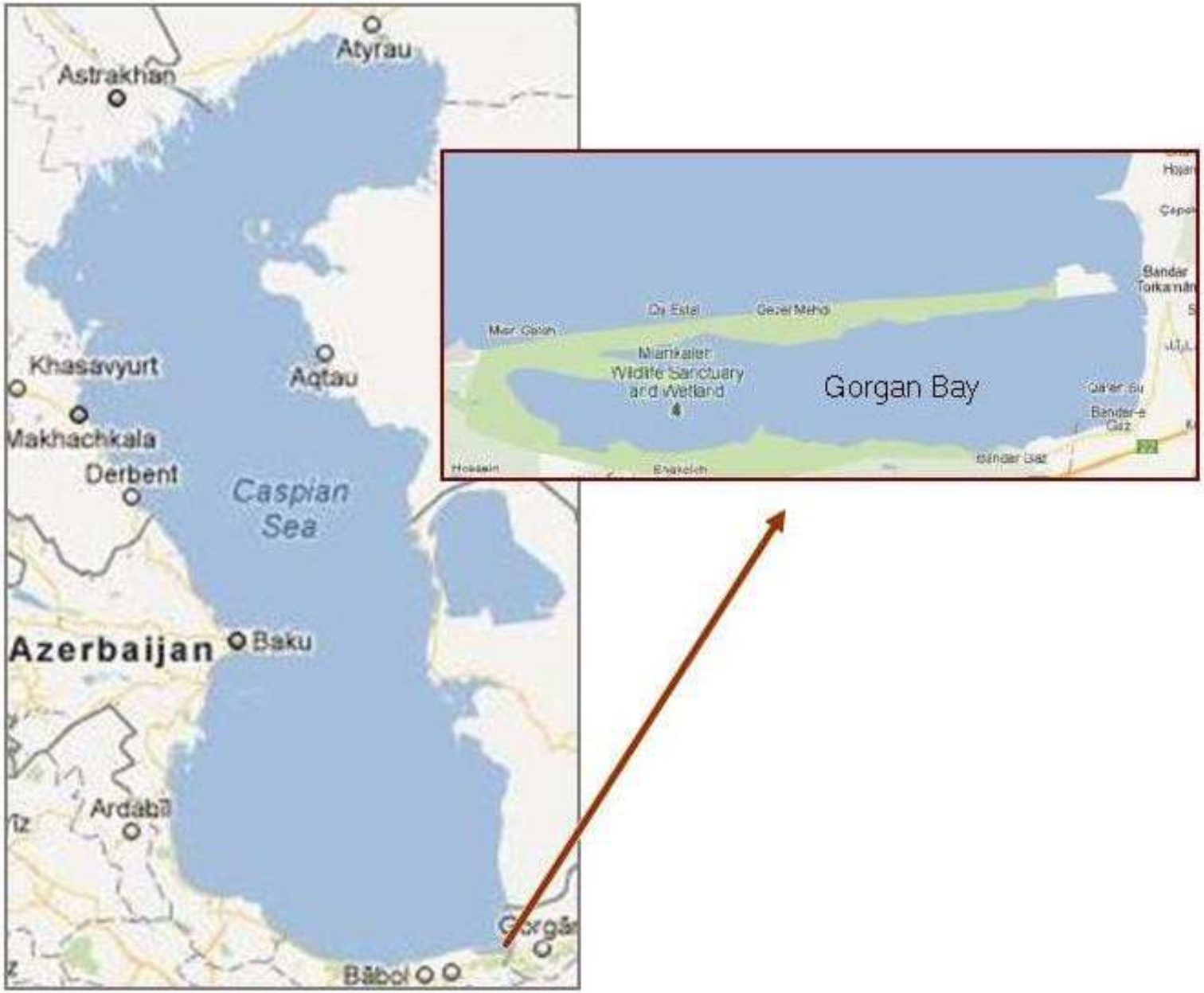
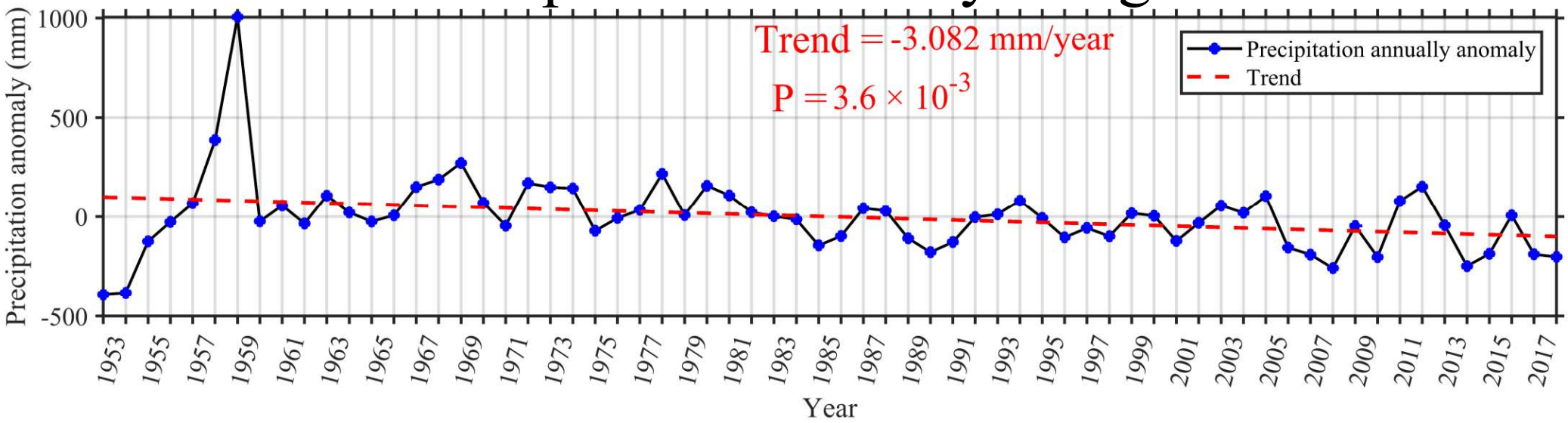
Climate Change impacts

- Heat wave
- Heavy precipitation event (Flooding)
- Drought
- Tropical cyclones
- Wildfires
- Sea level rise
- Food availability

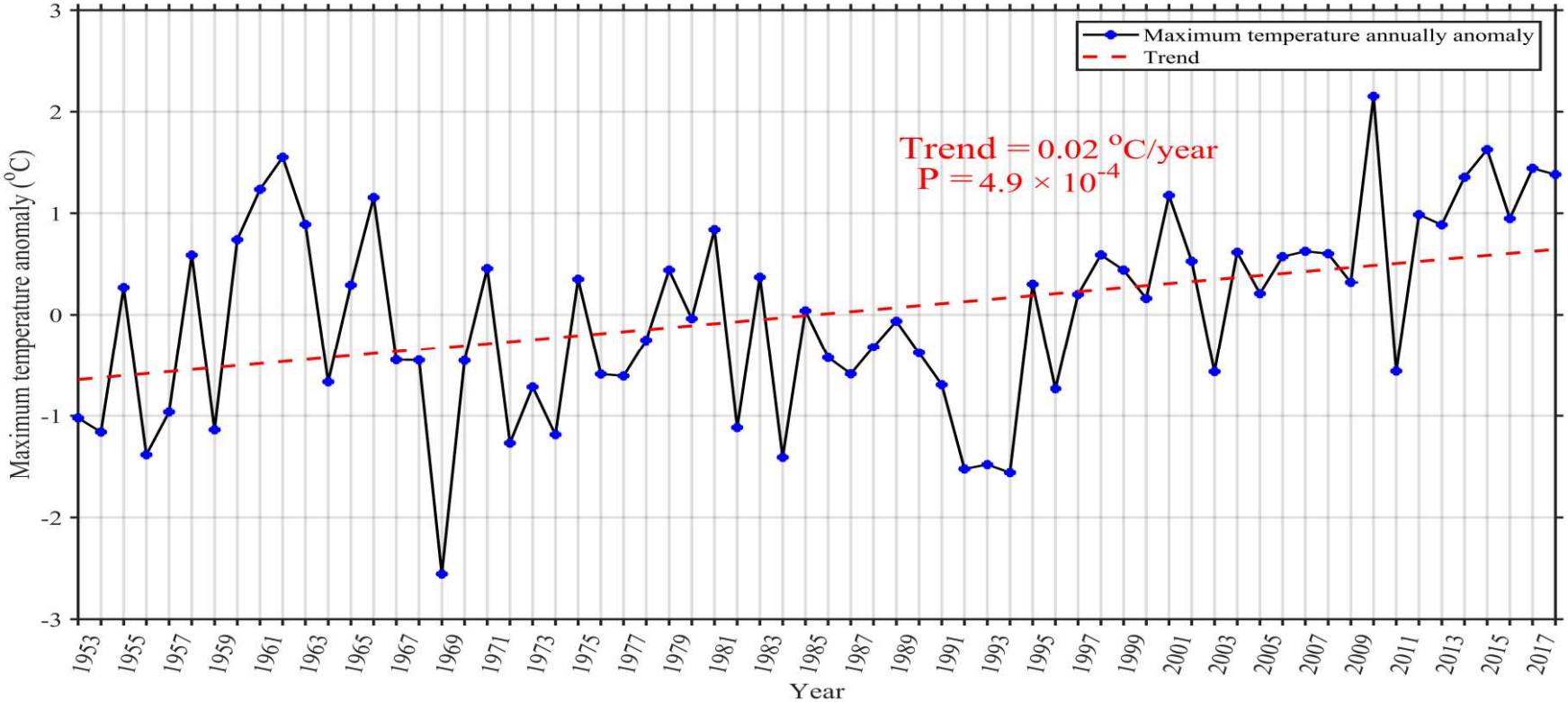
Gorgan Bay


Atyrau
Astrakhan
Khasavyurt
Aqtau
Makhachkala
Derbent
Caspian Sea
Azerbaijan
Baku
Ardabil
Babol
Gorgan Bay

Precipitation anomaly-Gorgan



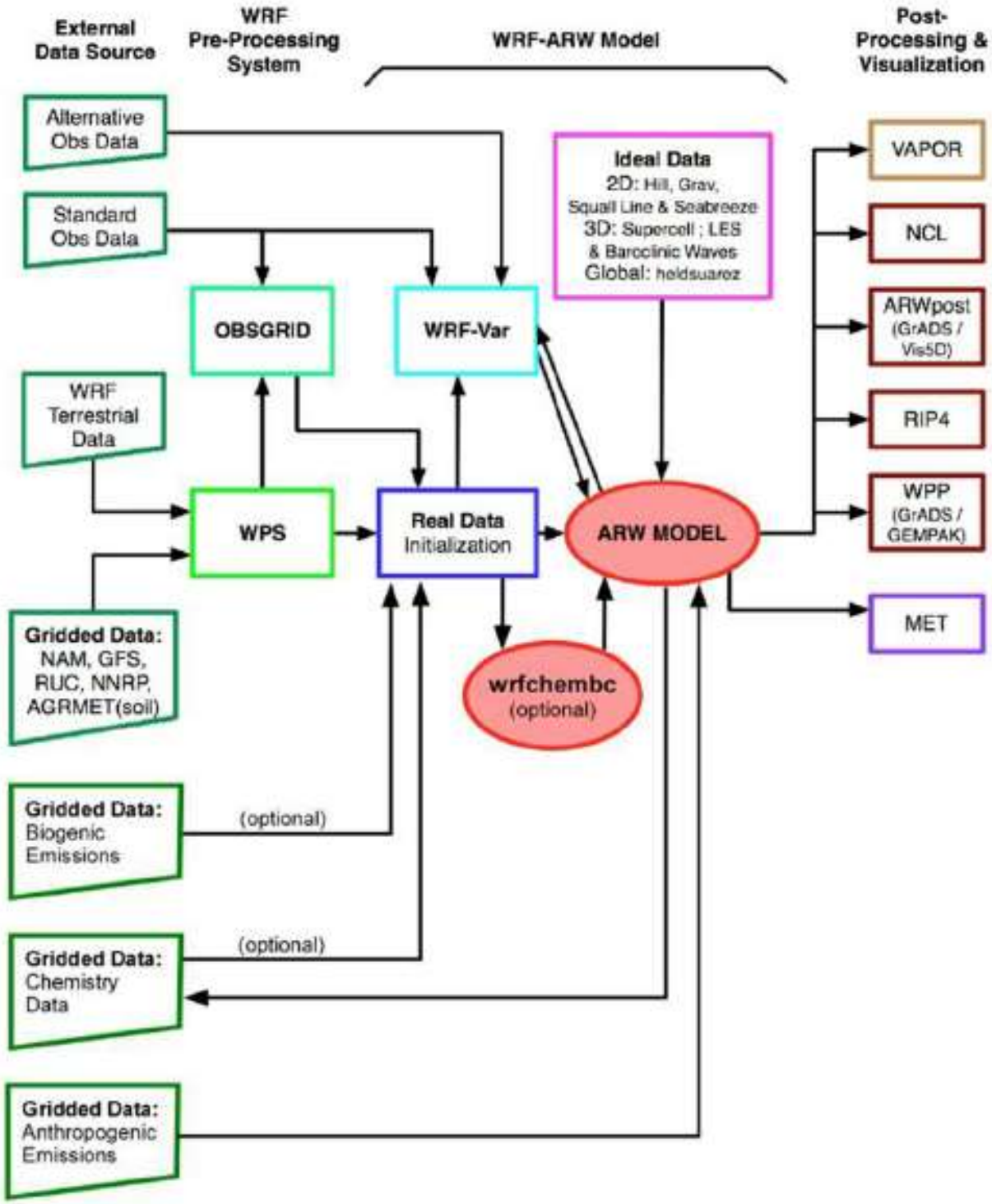
Maximum temperature anomaly-Gorgan



Methods

- Observation data
  - Synoptic stations
  - ERA5 reanalysis
  - Satellite
- Numerical simulation
  - WRF/Chem
  - HYSPLIT

WRF/Chem


External Data Source
WRF Pre-Processing System
WRF-ARW Model
Post-Processing & Visualization
Alternative Obs Data
Standard Obs Data
Ideal Data
2D: Hill, Grav, Squall Line & Seabreeze
3D: Supercell ; LES & Baroclinic Waves
Global: heldsuarez
VAPOR
NCL
ARWpost (GrADS / Vis5D)
RIP4
WPP (GrADS / GEMPAK)
MET
OBSGRID
WRF-Var
WRF Terrestrial Data
WPS
Real Data Initialization
ARW MODEL
Gridded Data: NAM, GFS, RUC, NNRP, AGRMET(soil)
wrfchembc (optional)
Gridded Data: Biogenic Emissions
(optional)
Gridded Data: Chemistry Data
(optional)
Gridded Data: Anthropogenic Emissions

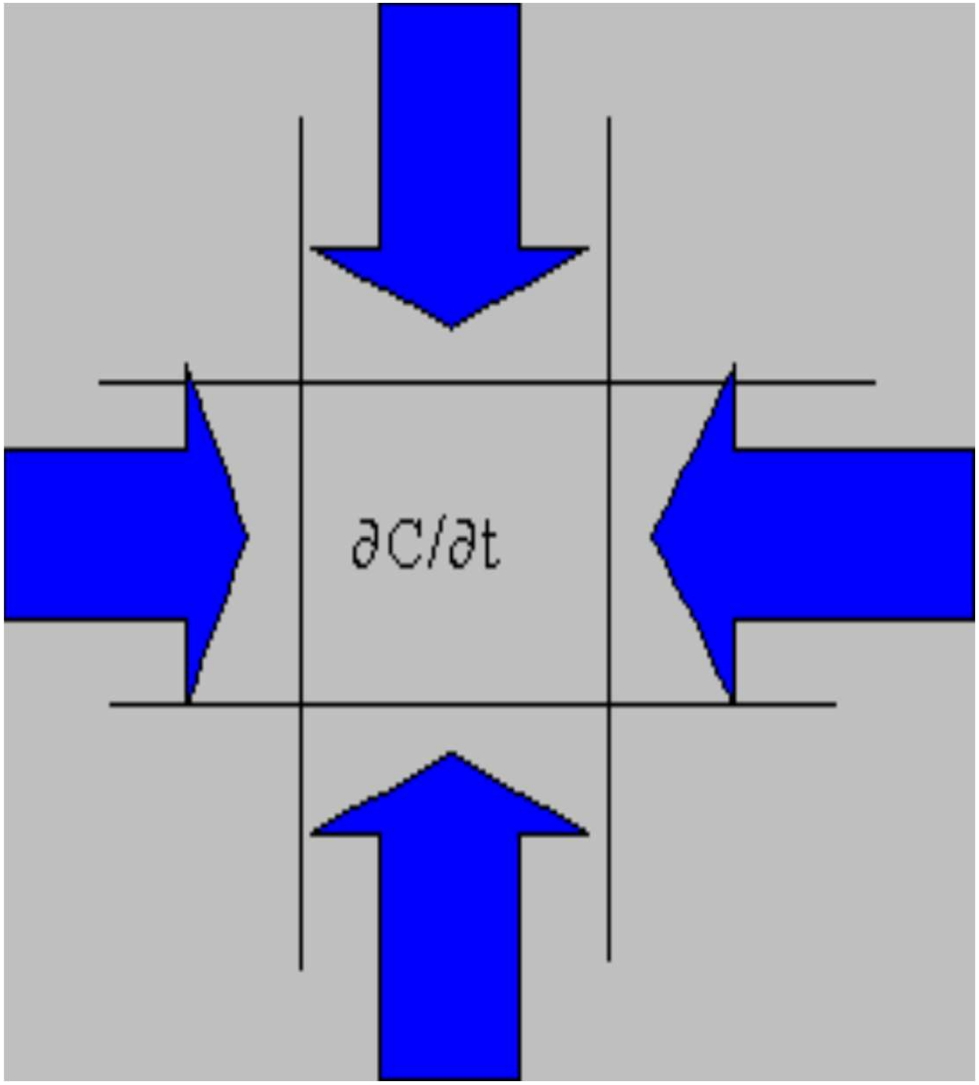
Physical model parameterizations

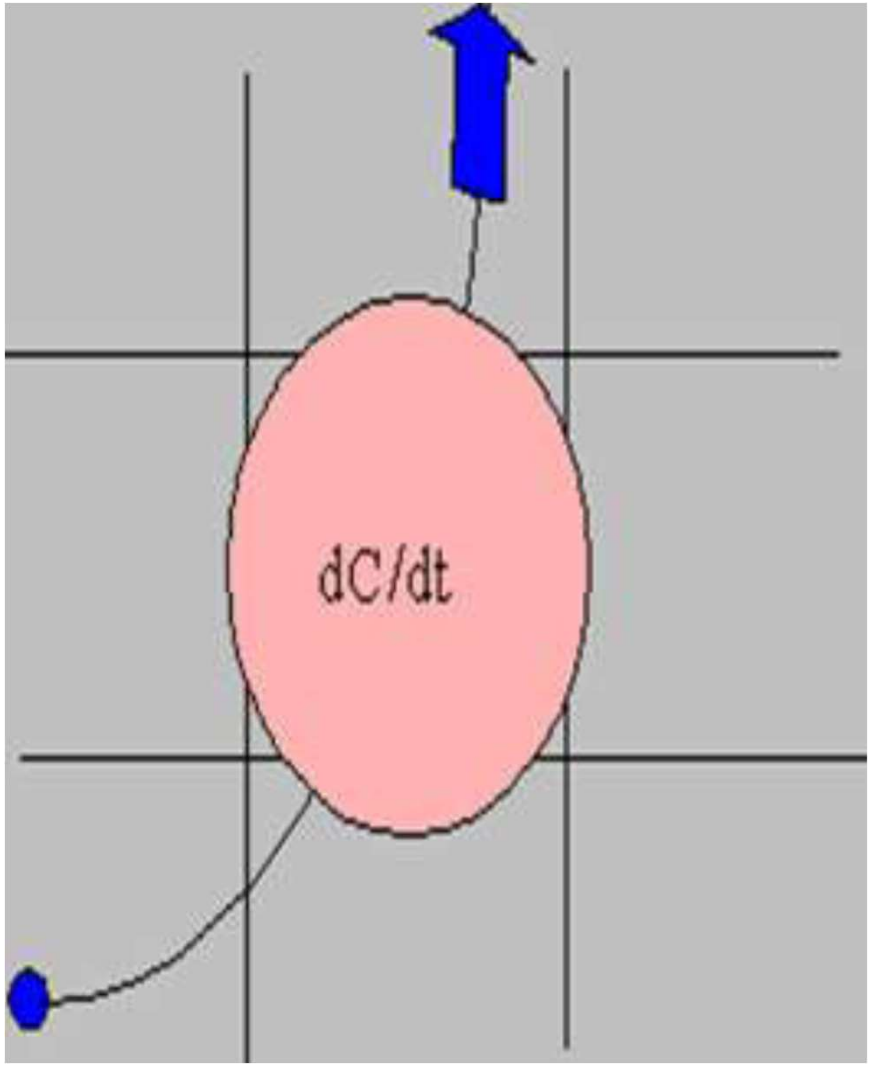
Parameterization	Schemes
Surface layer	**MM5 similarity**
Boundary layer	**Yonsei University**
Surface	**5-layer**
Long wave radiation	**RRTM scheme**
Short wave radiation	**Dudhia**
Microphysics	**Goddard GCE scheme**

Land vegetation options

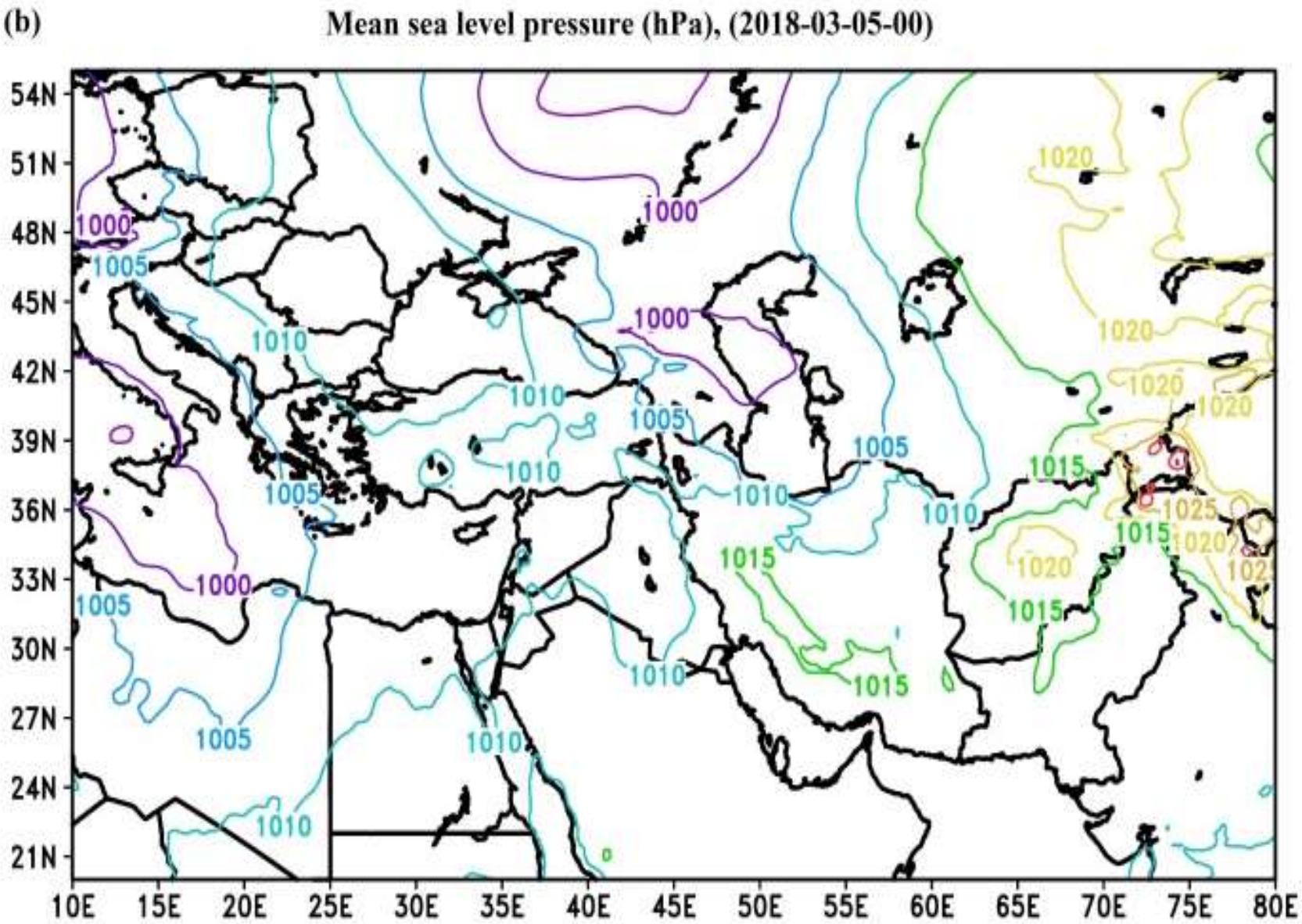
- 1, 15., .10, .88, 80., 3., 1.67, 18.9e5,'Urban and Built-Up Land'
  2, 17., .30, .985, 15., 4., 2.71, 25.0e5,'Dryland Cropland and Pasture'
  3, 18., .50, .985, 10., 4., 2.20, 25.0e5,'Irrigated Cropland and Pasture'
  4, 18., .25, .985, 15., 4., 2.56, 25.0e5,'Mixed Dryland/Irrigated Cropland and Pasture'
  5, 18., .25, .98, 14., 4., 2.56, 25.0e5,'Cropland/Grassland Mosaic'
  6, 16., .35, .985, 20., 4., 3.19, 25.0e5,'Cropland/Woodland Mosaic'
  7, 19., .15, .96, 12., 3., 2.37, 20.8e5,'Grassland'
  8, 22., .10, .93, 5., 3., 1.56, 20.8e5,'Shrubland'
  9, 20., .15, .95, 6., 3., 2.14, 20.8e5,'Mixed Shrubland/Grassland'
  10, 20., .15, .92, 15., 3., 2.00, 25.0e5,'Savanna'
  11, 16., .30, .93, 50., 4., 2.63, 25.0e5,'Deciduous Broadleaf Forest'
  12, 14., .30, .94, 50., 4., 2.86, 25.0e5,'Deciduous Needleleaf Forest'
  13, 12., .50, .95, 50., 5., 1.67, 29.2e5,'Evergreen Broadleaf Forest'
  14, 12., .30, .95, 50., 4., 3.33, 29.2e5,'Evergreen Needleleaf Forest'
  15, 13., .30, .97, 50., 4., 2.11, 41.8e5,'Mixed Forest'
  16, 8., 1.0, .98, 0.01, 6., 0., 9.0e25,'Water Bodies'
  17, 14., .60, .95, 20., 6., 1.50, 29.2e5,'Herbaceous Wetland'
  18, 14., .35, .95, 40., 5., 1.14, 41.8e5,'Wooded Wetland'
  19, 25., .02, .90, 1., 2., 0.81, 12.0e5,'Barren or Sparsely Vegetated'
  20, 15., .50, .92, 10., 5., 2.87, 9.0e25,'Herbaceous Tundra'
  21, 15., .50, .93, 30., 5., 2.67, 9.0e25,'Wooded Tundra'
  22, 15., .50, .92, 15., 5., 2.67, 9.0e25,'Mixed Tundra'
  23, 25., .02, .90, 10., 2., 1.60, 12.0e5,'Bare Ground Tundra'
  24, 55., .95, .95, 0.1, 5., 0., 9.0e25,'Snow or Ice'
  25, 30., .40, .90, 1., 5., .62, 12.0E5,'Playa'
  26, 18., .50, .95, 15., 6., .62, 12.0E5,'Lava'
  27, 70., .40, .90, 1., 5., 0., 12.0E5,'White Sand'
  28, 15., .02, .88, 80., 3., 1.67, 18.9e5,'Unassigned'
  29, 15., .02, .88, 80., 3., 1.67, 18.9e5,'Unassigned'
  30, 15., .10, .88, 80., 3., 1.67, 18.9e5,'Unassigned'
  31, 10., .10, .97, 80., 3., 1.67, 18.9e5,'Low Intensity Residential '
  32, 10., .10, .97, 80., 3., 1.67, 18.9e5,'High Intensity Residential'
  33, 10., .10, .97, 80., 3., 1.67, 18.9e5,'Industrial or Commercial

HYSPLIT model

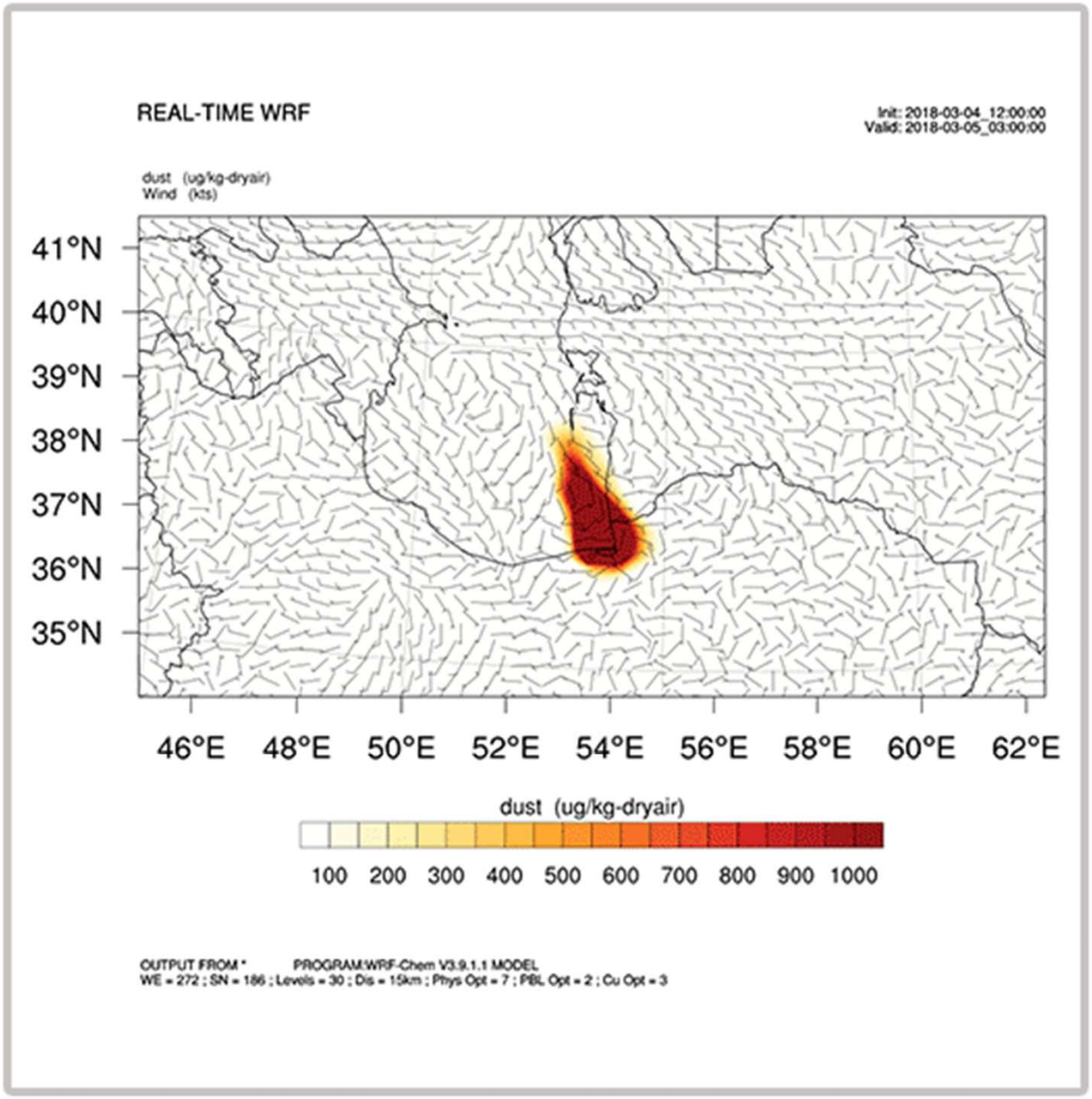




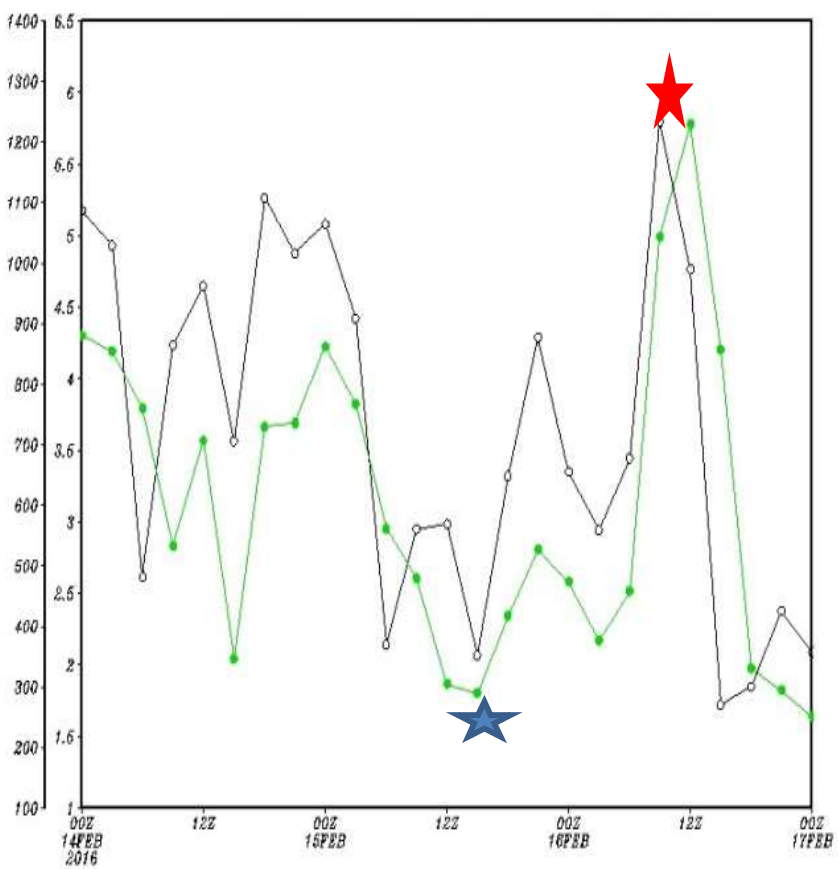
Dust event: 5 March 2018

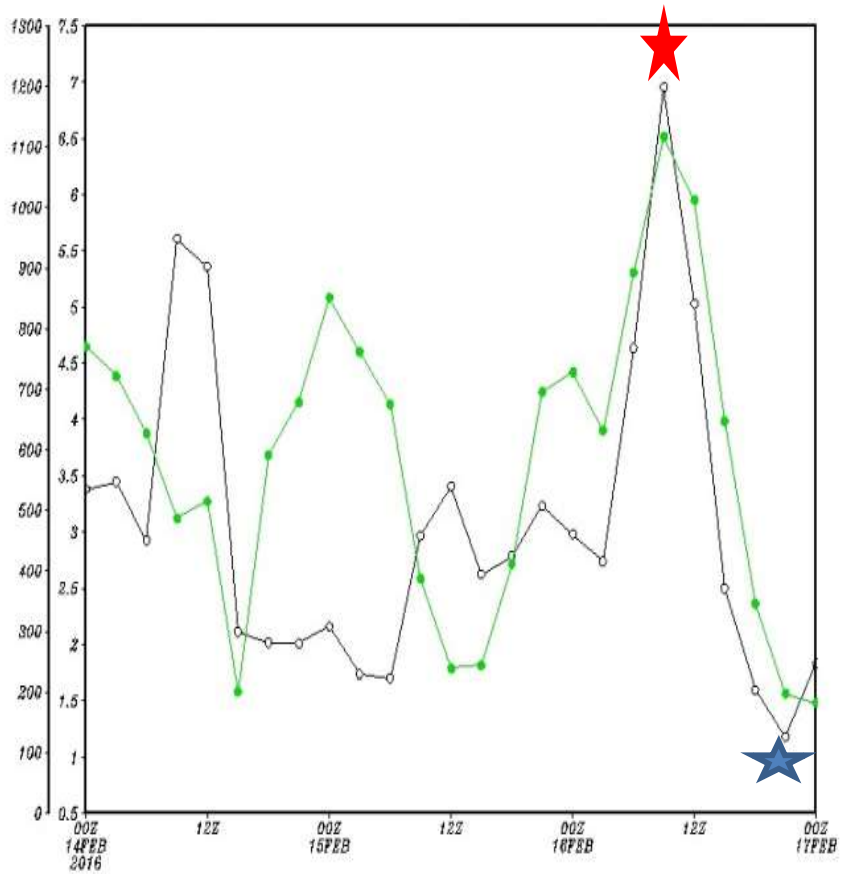


Dust concentration

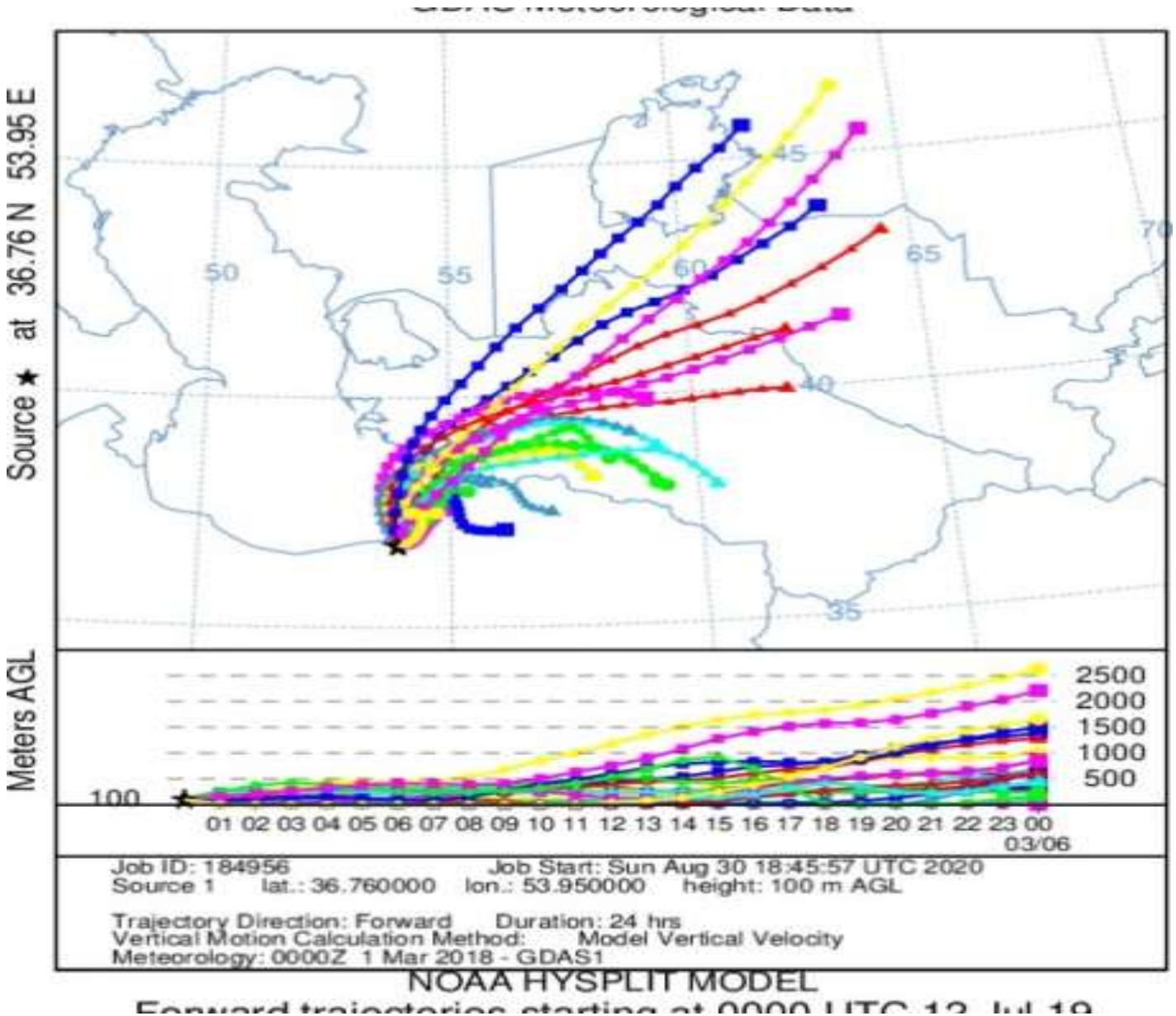


Wind speed and dust concentration





Dust trajectory



Summary

- Intensity of dust is strongly dependent on the wind speed in the Gorgan Bay area.
- The most intense dust events at Gorgan Bay occur when the atmospheric pattern indicates low-pressure and high-pressure contrast in the study area and the middle levels of the atmosphere are stable.
- Transfer of dust particles from the Gorgan Bay to the west, northeast, and south of the region.
- In general, the results showed that if the sea level of the Caspian Sea decreases, which results in the drying of the bay and its cover with grasslands, ***the Gorgan Bay can be considered as a source of dust.***

Thank you for
your attention