Influence of the initial and boundary conditions on mesoscale simulations using the WRF v3.9.1 model in Sofia region

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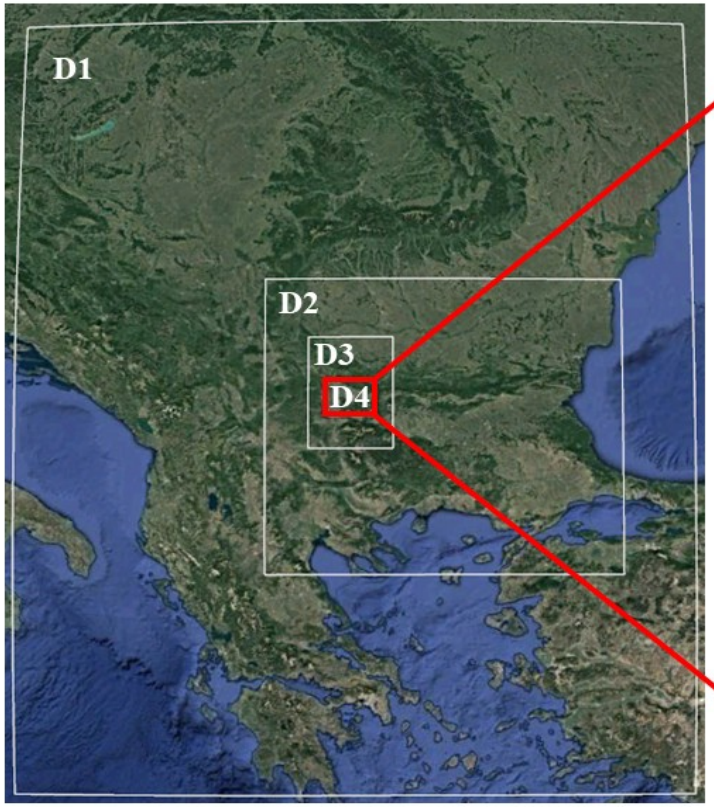
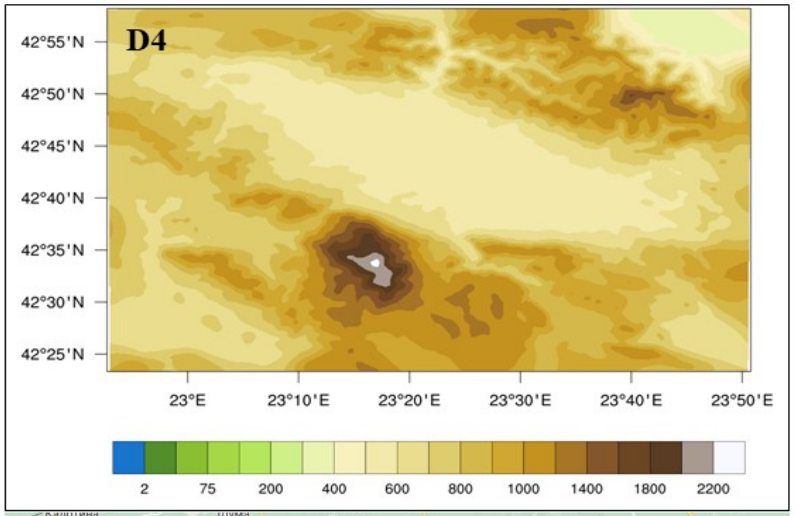
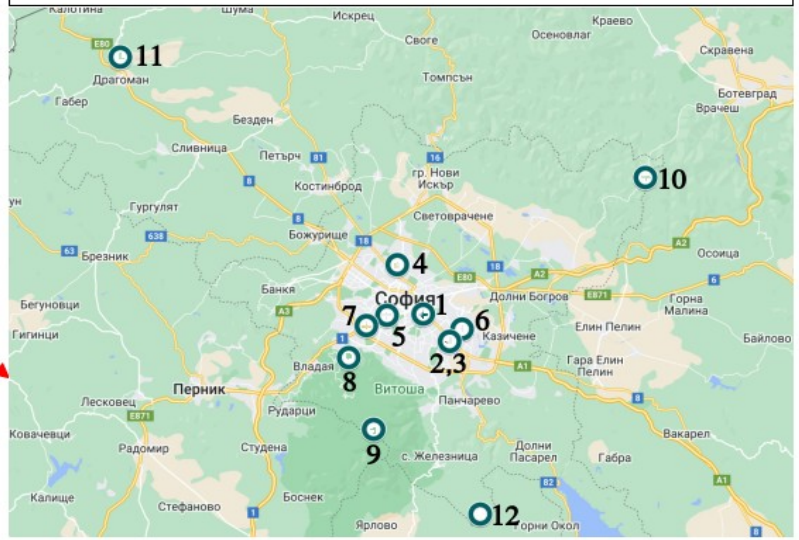
NUMERICAL MODEL – WRF v3.9.1







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NUMERICAL MODEL – WRF v3.9.1

- 100 ETA levels
- 500 m horizontal rezolution
- High resolution topography data - approximately 30 m
- Corine land-cover dataset - approximately 90 m

The WRF physics package

- Longwave radiation parameterization - the Rapid Radiative Transfer Model (RRTM) (Mlawer et al., 1997),
- Shortwave radiation parameterization (Dudhia, 1989), which computes radiation at fine time scales (every 10 min)
- Land surface model scheme – Noah (Chen&Dudhia, 2001) is chosen
- PBL scheme - Quasi-Normal Scale Elimination scheme (TKE prediction option), QNSE (Sukoriansky et al., 2005).
- Microphysics scheme is Thompson (Thompson et al., 2008).

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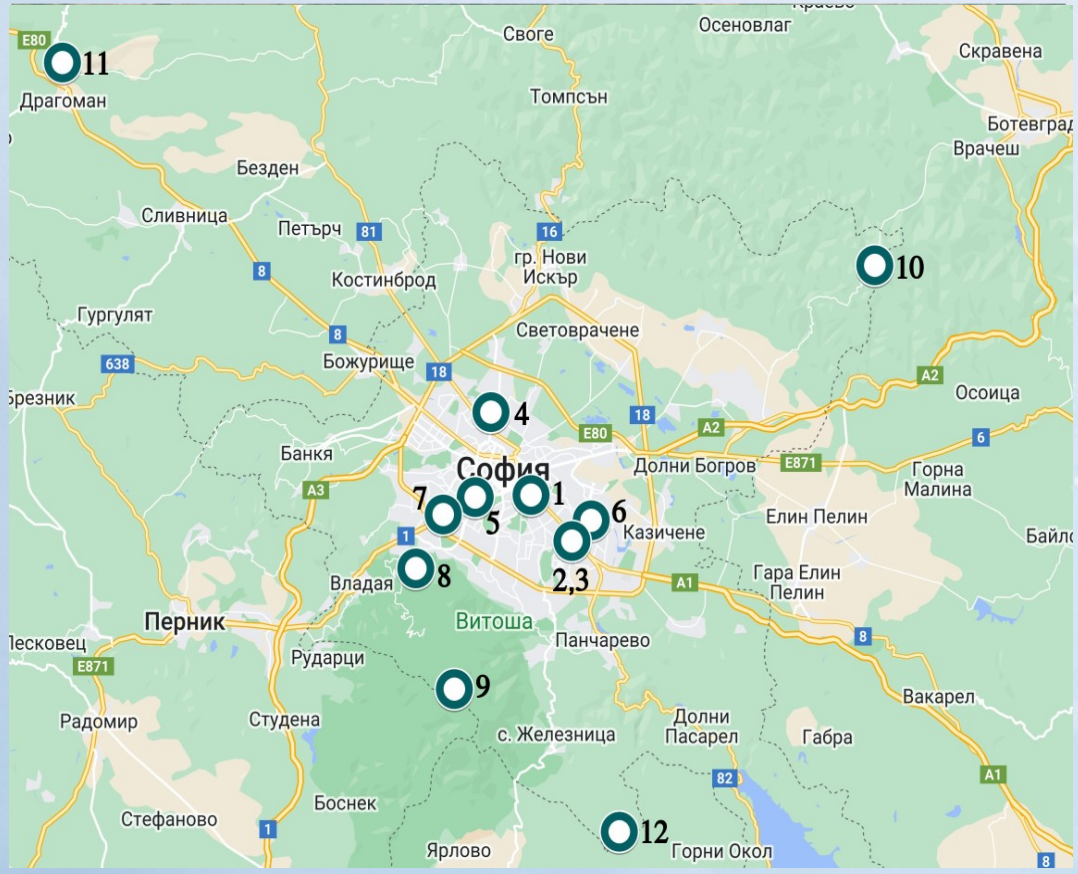
OBSERVATIONS



Name	Station altitude [m]
8. Kopitoto	1321
4. Nadezhda	534
1. Borisova gradina	577
12. Plana	1234
5. Pavlovo	615
6. Druzhba	548
7. Hipodruma	581
2. Sofia - NIMH	552
3. Sofia - Mladost	552
9. Cherni vrah	2286
10. Murgash	1687
11. Dragoman Драгоман	716

Observation Stations:
- SYNOP
- radiosonde
- automatic

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INITIAL AND BOUNDARY CONDITIONS

NCEP/GFS	ECMWF
0.25 degrees, 31 km	0.25 degrees, 31 km
6 hours	6 hours (every 1 hour available)
26 mandatory levels up to 10 hPa	37 mandatory levels up to 10 hPa
~ 40 surface and vertical parameters Surface pressure, sea level pressure, geopotential height, temperature, sea surface temperature, soil values, ice cover, relative humidity, u- and v- winds, vertical motion, vorticity and etc.	~ 30 surface and vertical parameters Surface pressure, sea level pressure, geopotential height, temperature, sea surface temperature, soil temperature and moist, ice cover, relative humidity, u- and v- winds, vertical motion, vorticity and etc.

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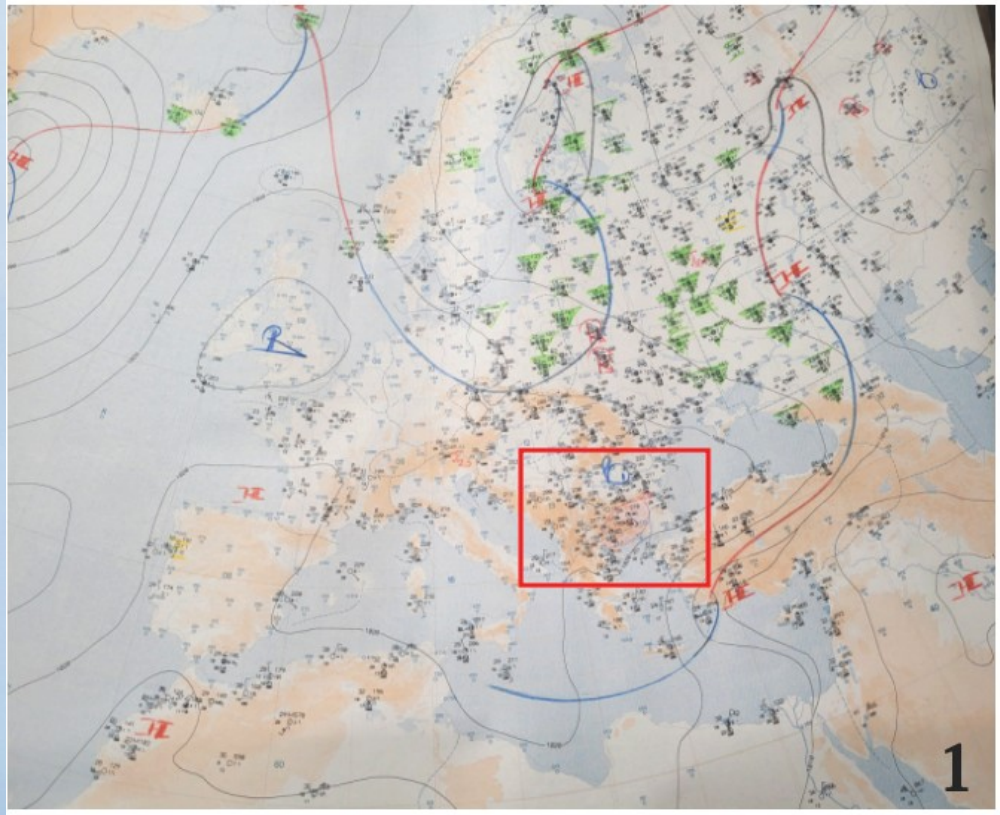
CASE 1 SYNOPSIS - 13-15.08.2016



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RESULTS CASE 1 - 13-15.08.2016

Summary of surface statistics

ALL STATIONS		Mean	St. Dev.	MB	ME	RMSE	IA	r
TEMPERATURE								
13.08-15.08	**Observation**	16.32	4.85					
	Model data-GFS	16.52	4.38	0.20	1.27	1.55	0.96	0.97
	Model data – ECMWF	16.19	3.95	-0.13	1.52	1.85	0.95	0.95
RELATIVE HUMIDITY								
13.08-15.08	**Observation**	55.17	14.48					
	Model data-GFS	44.32	11.85	-10.85	12.83	14.39	0.77	0.90
	Model data – ECMWF	45.44	10.99	-9.73	12.59	14.48	0.75	0.89
WIND SPEED								
13.08-15.08	**Observation**	1.97	1.03					
	Model data-GFS	3.11	1.52	1.13	1.87	2.30	0.42	0.52
	Model data – ECMWF	3.33	1.73	1.36	2.03	2.56	0.39	0.47
WIND DIRECTION								
13.08-15.08	**Observation**	132.99	95.97					
	Model data-GFS	112.85	78.62	-20.14	96.68	129.74	0.45	0.10
	Model data – ECMWF	108.18	70.23	-24.81	92.48	122.29	0.48	0.17

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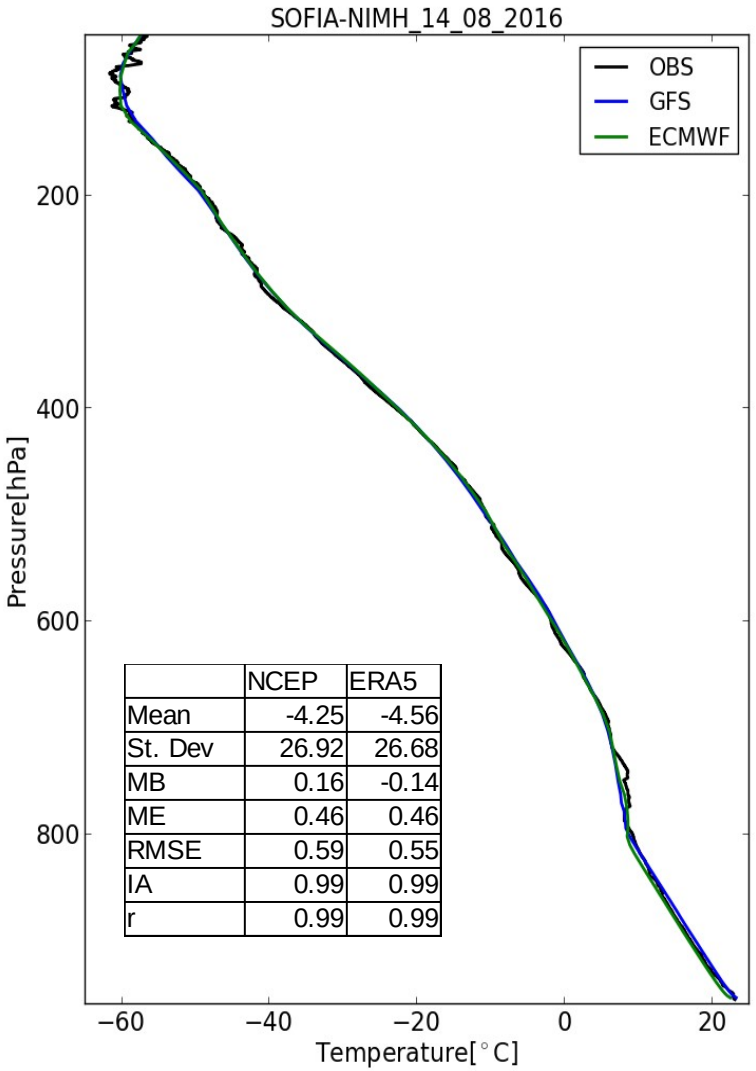
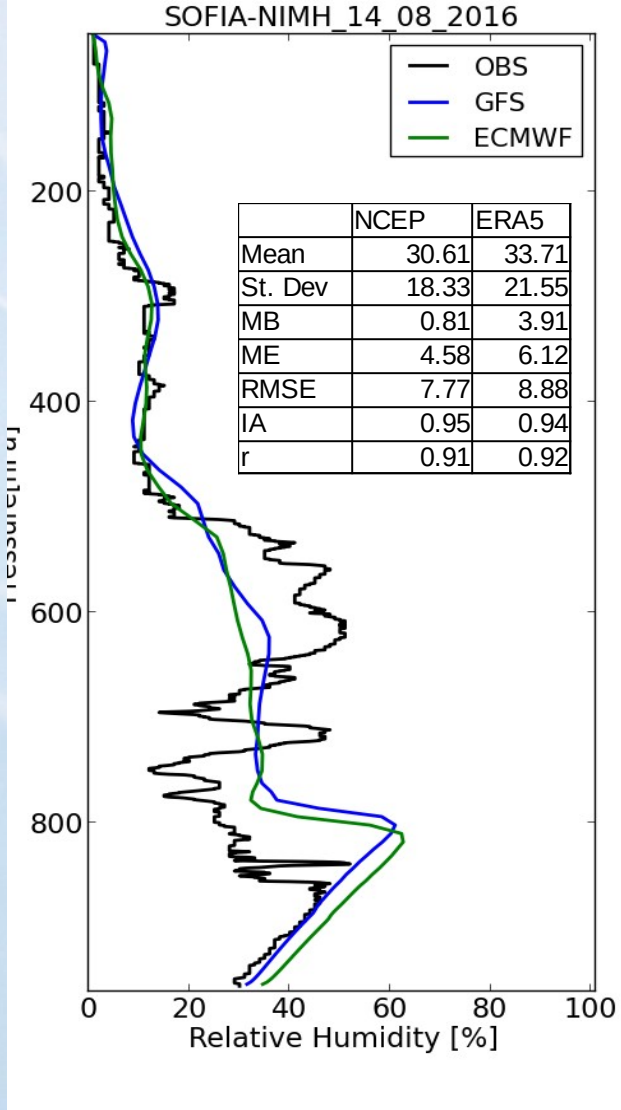
RESULTS CASE 1, VERTICAL COMPARISON



	NCEP	ERA5
Mean	-4.25	-4.56
St. Dev	26.92	26.68
MB	0.16	-0.14
ME	0.46	0.46
RMSE	0.59	0.55
IA	0.99	0.99
r	0.99	0.99



	NCEP	ERA5
Mean	30.61	33.71
St. Dev	18.33	21.55
MB	0.81	3.91
ME	4.58	6.12
RMSE	7.77	8.88
IA	0.95	0.94
r	0.91	0.92

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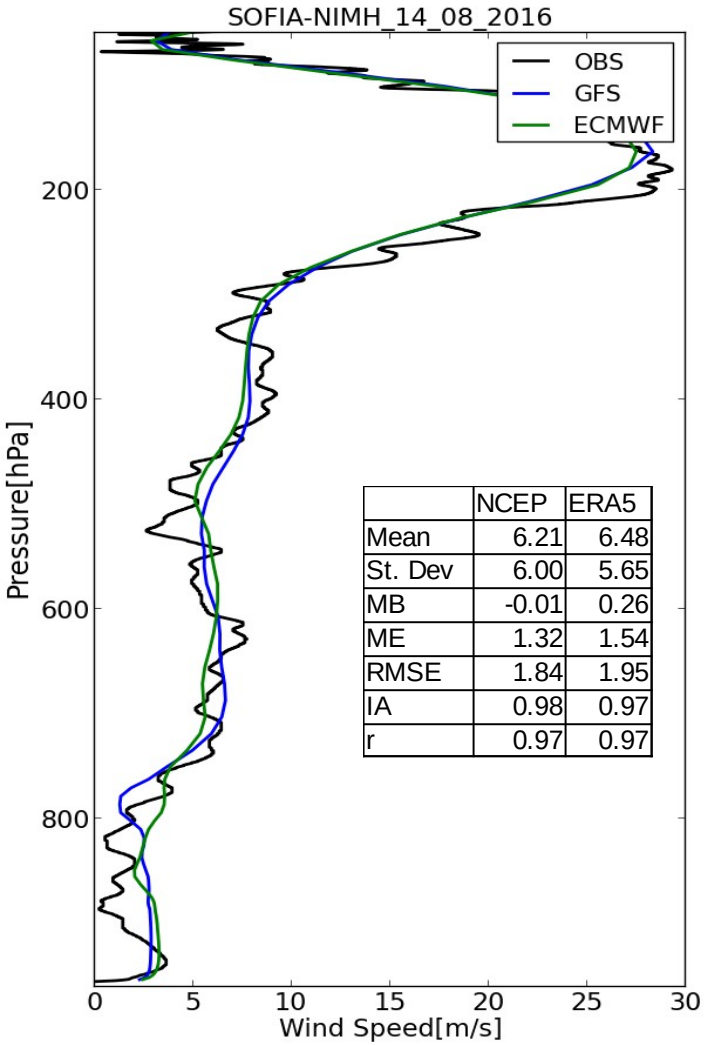
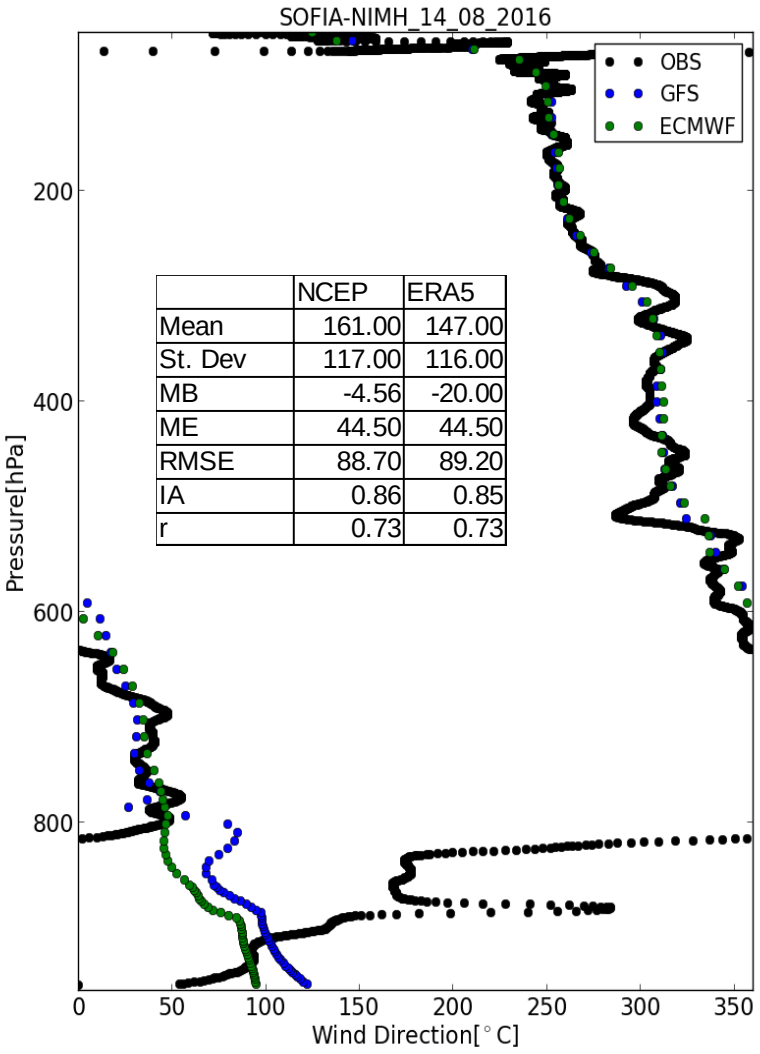
RESULTS CASE 1, VERTICAL COMPARISON



	NCEP	ERA5
Mean	6.21	6.48
St. Dev	6.00	5.65
MB	-0.01	0.26
ME	1.32	1.54
RMSE	1.84	1.95
IA	0.98	0.97
r	0.97	0.97



	NCEP	ERA5
Mean	161.00	147.00
St. Dev	117.00	116.00
MB	-4.56	-20.00
ME	44.50	44.50
RMSE	88.70	89.20
IA	0.86	0.85
r	0.73	0.73

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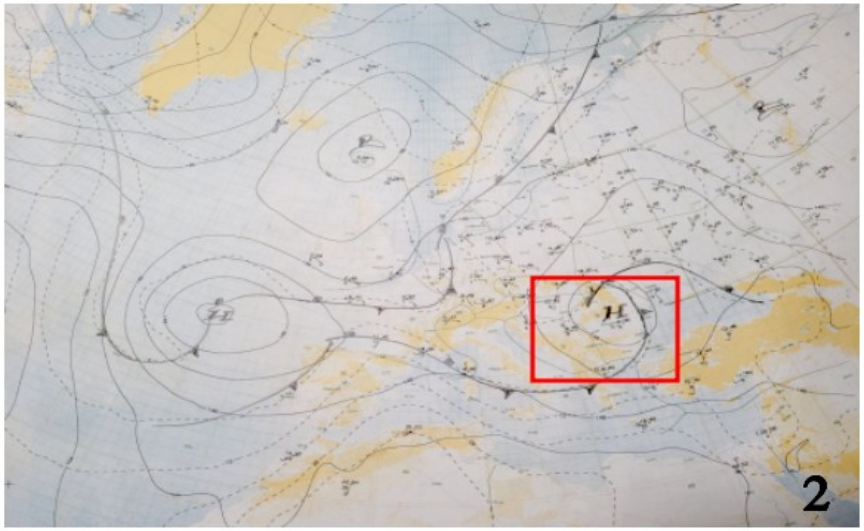
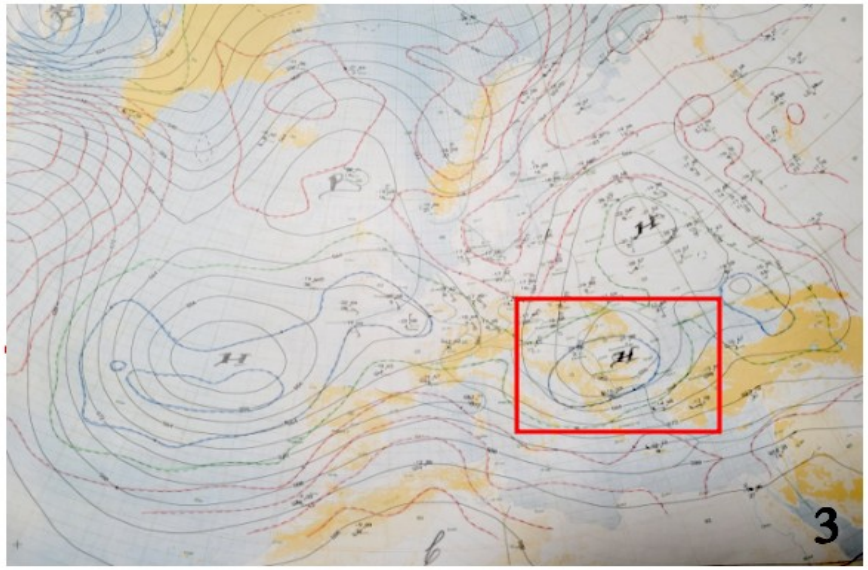
CASE 2 SYNOPSIS, 24-26.05.2016





Influence of the initial and boundary conditions on mesoscale simulations using the WRF v3.9.1 model in Sofia region

RESULTS CASE 2 - 24-26.05.2016

Summary of surface statistics

ALL STATIONS		Mean	St. Dev.	MB	ME	RMSE	IA	r
TEMPERATURE								
24.05-26.05	**Observation**	12.17	3.04					
	Model data-GFS	12.76	3.42	0.59	1.38	1.84	0.91	0.88
	Model data – ECMWF	12.96	3.15	0.79	1.36	1.78	0.91	0.90
RELATIVE HUMIDITY								
24.05-26.05	**Observation**	72.07	14.05					
	Model data-GFS	56.12	11.81	-15.95	18.41	21.18	0.59	0.54
	Model data – ECMWF	55.37	10.62	-16.70	18.85	21.44	0.58	0.56
WIND SPEED								
24.05-26.05	**Observation**	5.84	2.28					
	Model data-GFS	5.65	1.83	-0.19	4.65	5.21	0.43	0.52
	Model data – ECMWF	5.83	1.89	0.00	4.53	5.13	0.43	0.52
WIND DIRECTION								
24.05-26.05	**Observation**	250.24	65.81					
	Model data-GFS	270.24	56.28	20.00	47.29	67.64	0.66	0.49
	Model data – ECMWF	275.37	49.96	25.13	50.59	72.96	0.58	0.35

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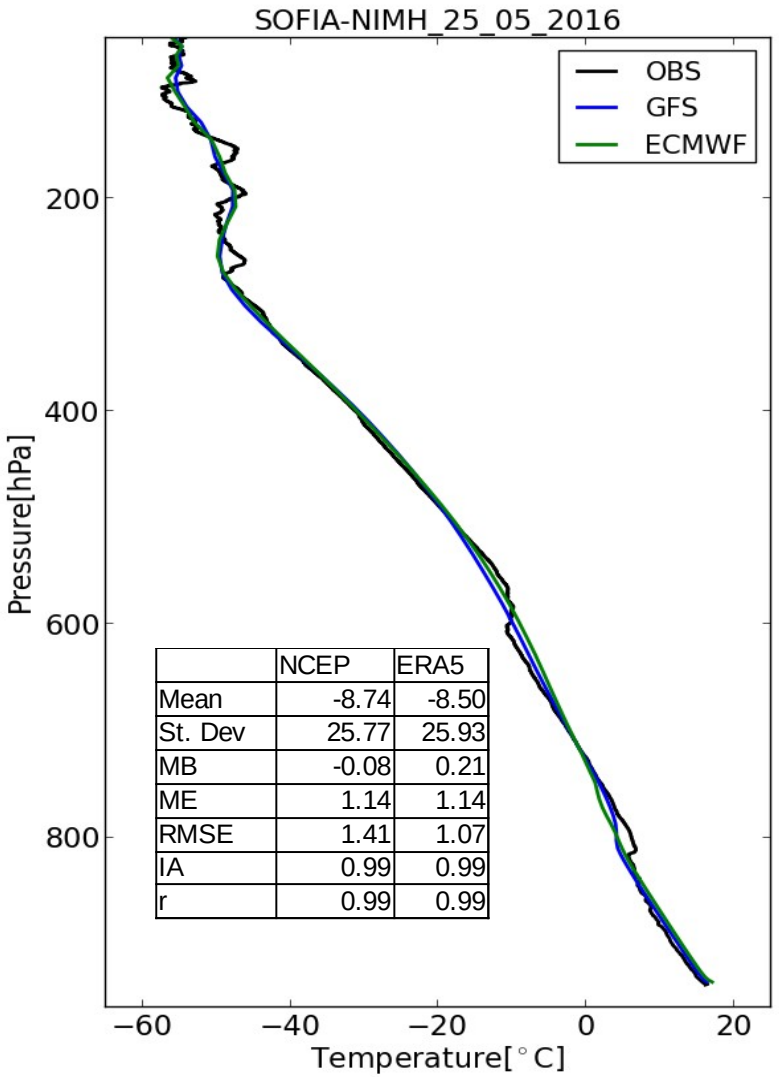
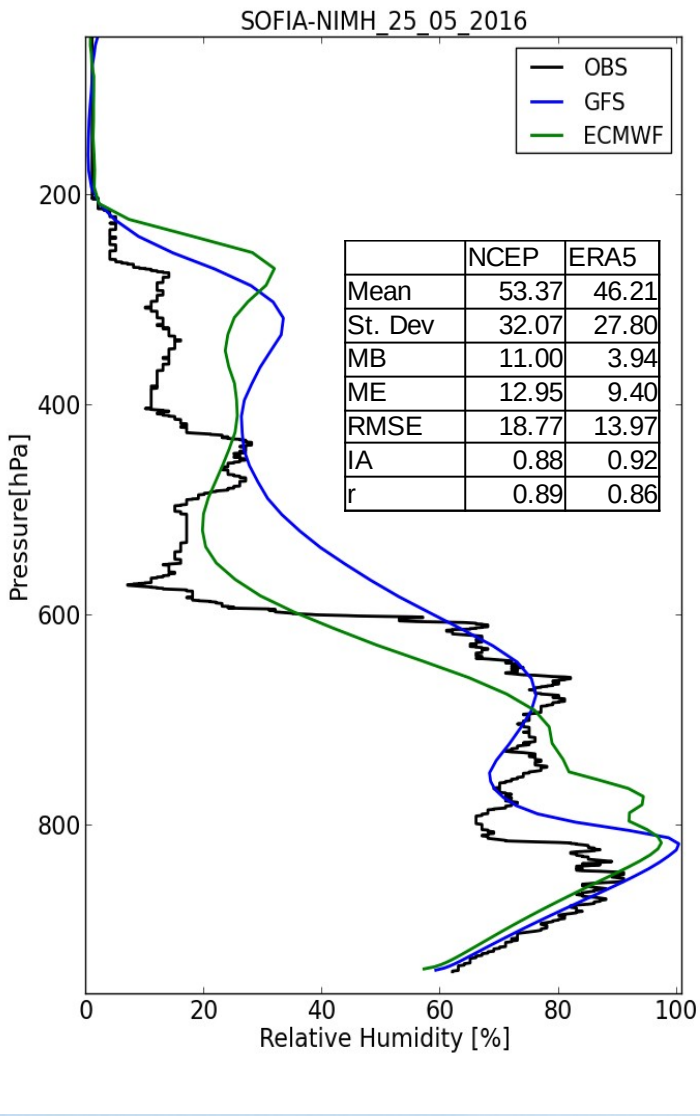
RESULTS CASE 2, VERTICAL COMPARISON



	NCEP	ERA5
Mean	-8.74	-8.50
St. Dev	25.77	25.93
MB	-0.08	0.21
ME	1.14	1.14
RMSE	1.41	1.07
IA	0.99	0.99
r	0.99	0.99



	NCEP	ERA5
Mean	53.37	46.21
St. Dev	32.07	27.80
MB	11.00	3.94
ME	12.95	9.40
RMSE	18.77	13.97
IA	0.88	0.92
r	0.89	0.86

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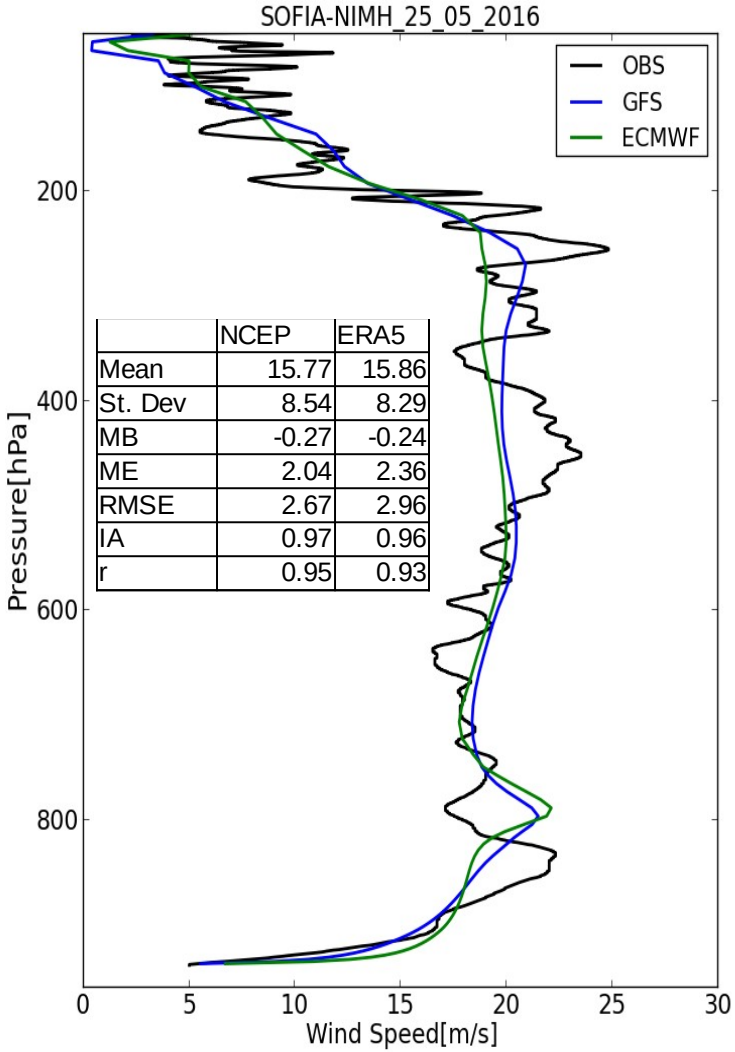
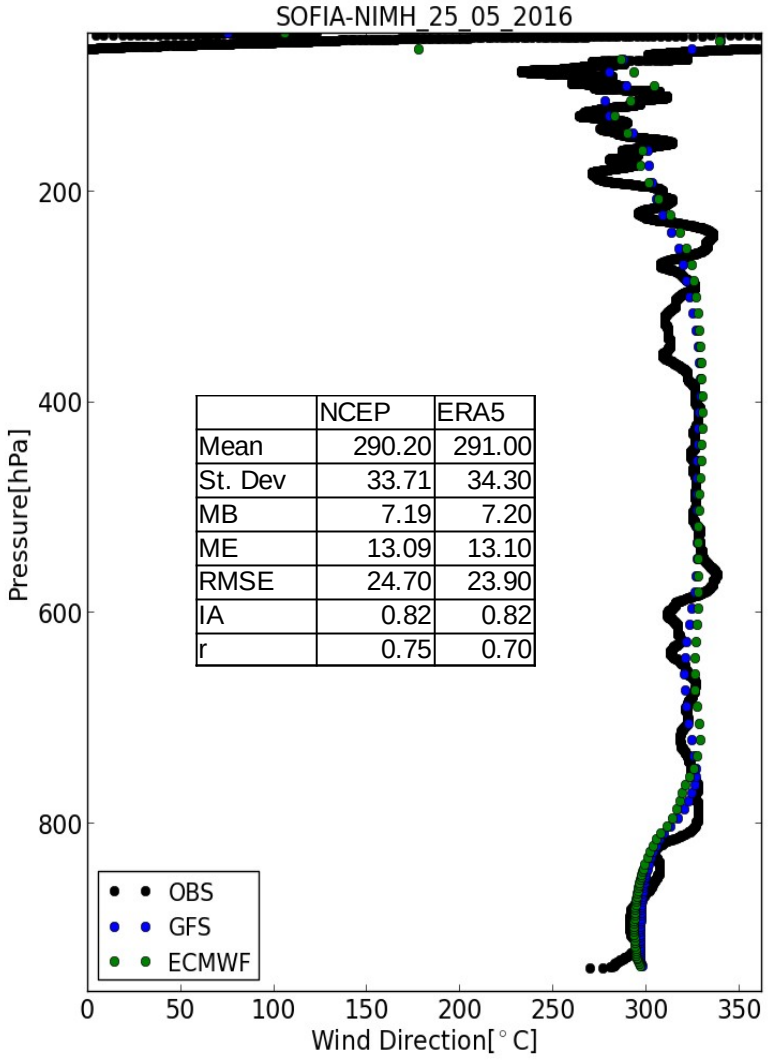
RESULTS CASE 2, VERTICAL COMPARISON



	NCEP	ERA5
Mean	15.77	15.86
St. Dev	8.54	8.29
MB	-0.27	-0.24
ME	2.04	2.36
RMSE	2.67	2.96
IA	0.97	0.96
r	0.95	0.93



	NCEP	ERA5
Mean	290.20	291.00
St. Dev	33.71	34.30
MB	7.19	7.20
ME	13.09	13.10
RMSE	24.70	23.90
IA	0.82	0.82
r	0.75	0.70

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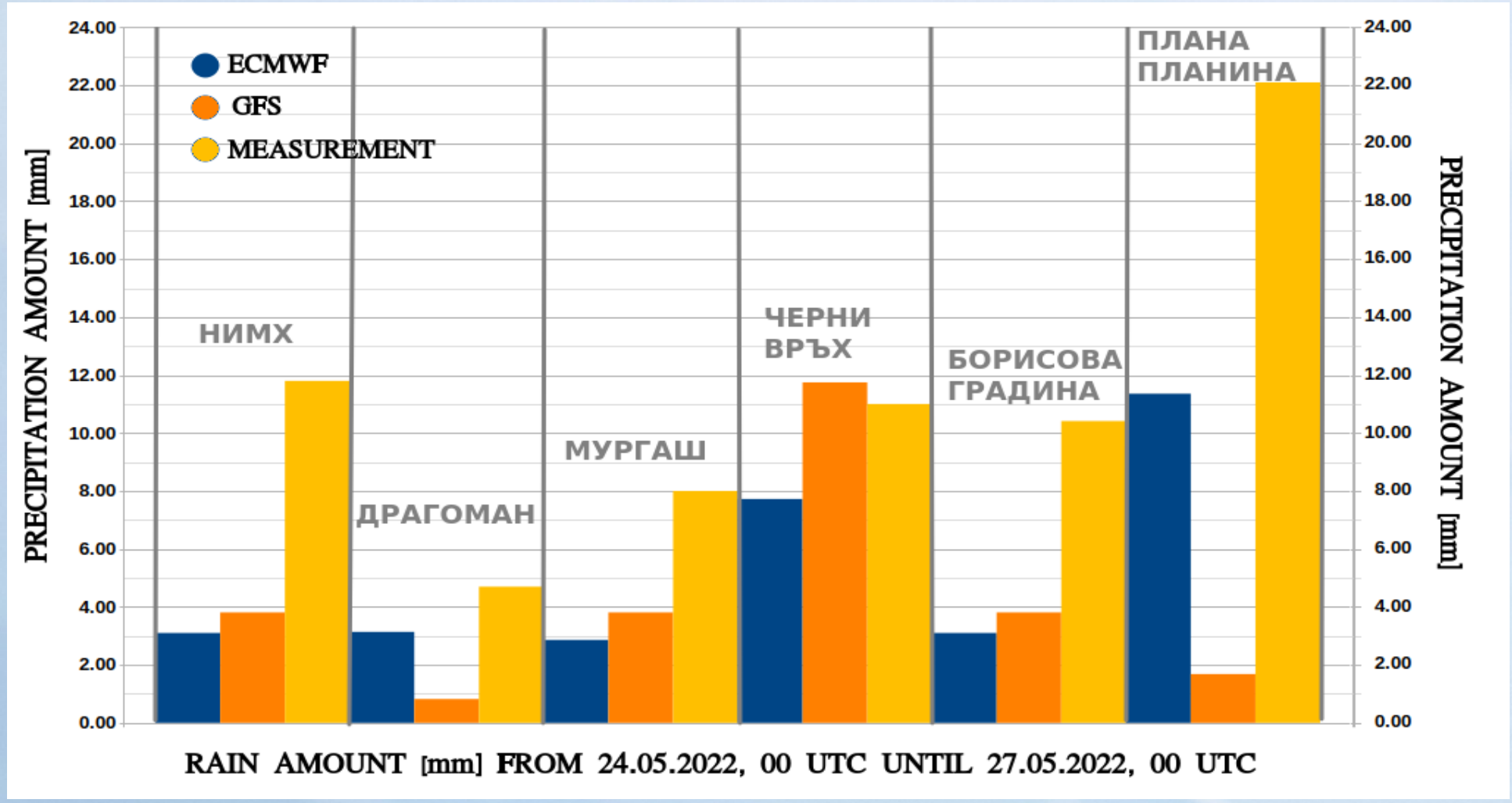
RESULTS CASE 2, PRECIPITATION



RESULTS

■ WRF model describes very well surface and vertical profile temperature for all stations and days

■ Comparison for the relative humidity showed very good agreement for Case 1, and slight not so good for Case 2

■ Comparison of surface wind speed and direction is for all stations - automatic and SYNOP stations - are they representative???

■ Comparison radiosonde profiles of wind speed and direction wind WRF results showed good agreement

■ Rain amount for Case 2 showed that WRF model is dryer than the actual measurements. A different microphysics scheme can be used for improvement of the results of the precipitation.

■ For the selected cases there is no significant advantage for some of the meteorological parameters forecasted with WRF model with initial and boundary condiditons from NCEP and ERA5

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Thank you for your attention!

RESULTS

■ For the selected cases there is no significant advantage of numerical simulation with initial and boundary conditions from NCEP and ERA5 for all compared meteorological parameters.

■ WRF model describes very well surface and vertical profile temperature for all stations and days
■ Comparison for the surface relative humidity showed very good agreement for Case 1, and slight not so good for Case 2.
■ Comparison of surface wind speed and direction is for all stations - automatic and SYNOP stations - are they representative???

■ Comparison radiosonde profiles for all parameters temperature, relative humidity, wind speed and direction WRF results showed very good agreement.

■ Rain amount for Case 2 showed that WRF model is dryer than then actual measurements.
A different microphysics scheme can be used for improvement of the results of the precipitation.