



01

The Application of Different Aerosol Climatologies in ICON Model over the Central and Eastern Mediterranean for the Year 2023

Euripides Avgoustoglou, Hellenic National Meteorological Service (HNMS) In Support and Collaboration with,

Harel Muskatel, Pavel Khain and Yoav Levi, Israel Meteorological Service (IMS) 26th COSMO General Meeting, Frankfurt- Offenbach, September 2-6, 2024





WORK OVERVIEW

- The goal of this effort is to assess and evaluate the new radiation code of ICON model over five aerosol climatologies under the second phase of Priority Project CAIIR (Clouds and Aerosols Improvements in ICON Radiation Scheme).
- A significant investment of time was genuinely and generously provided by IMS (Mainly H.M.) to port ICON-IMS, along with the corresponding technical developments, in a working mode to the account of E.A. at the ECMWF ATOS Supercomputing System
- A significant amount of computational and storage resources was provided, gratis from HNMS, to account for the exceptional demands of the resulting endeavor.
- Upon the completion of the Model runs, a "factory" of GrADs scripts was developed by E.A. at ECMWF to create a very large number of graphs (~10000 per case) as well as the necessary asciis associated with the specific locations of the available Greek synoptic meteorological stations
- A tentative presentation of the Status, and Prospects of the accomplished Task along with some exciting Highlights will be addressed.





TESTS BLUEPRINT

5 aerosol climatologies were considerd.

\otimes

22

The evaluation period consisted of the year 2023 (365+1 days).

- ~2000 runs based on ICON-IMS starting at 00 UTC daily:
- Horizontal grid size: R2B10 (~2.5km).
- 1621x1061 grid points (wider area of Central and Eastern Mediterranean)
- ♦ 65 levels.
- Integration time-step: 24 secs.
- Integration period: 48 hs. (An equivalent period of 10 years of model runs)
- Boundary conditions : 3hr IFS Forecast.
- Computational Cost of ~80 million b.u. on ATOS Supercomputing System of ECMWF (Gratis HNMS).
- Storage volume of ~20Tb at ECFS





Orography of the Integration Domain



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024





05

ENCODING OF THE TESTED AEROSOL CLIMATOLOGIES

- default: Reference setup with Tegen aerosol climatology.
- DeMott: DeMott 2015 ice nucleation scheme is used.
- IceOpt: New ice optical properties after *Muskatel et al. (2020)* including large hydrometeors in ecRAD.
- camsclim: CAMS climatology used (instead of Tegen).
- camsforc : CAMS forecasted aerosols used (instead of Tegen).



Surface Parameters considered (stored every 1h over the whole domain):

- asob_t: TOA net solar radiation mean since model start
- o asodifd_s: Surface down solar diffuse radiation mean since model start
- o asodird_s: Surface down solar direct radiation mean since model start
- athb_t: TOA net thermal radiation mean since model start
- o clch: High level clouds
- o clcl : Low level clouds
- o clcm: Mid level clouds
- \circ clct : Total cloud cover
- o gust10: Gust at 10 m since end of previous full 01H since model start
- pres_msl: Mean sea level pressure
- o rh_2m: Relative humidity in 2m
- sob_s: Shortwave net flux at surface
- sob_t : Shortwave net flux at TOA
- sodifd_s: Shortwave diffuse downward flux at surface
- sou_s: Shortwave upward flux at surface
- o t_2m: Temperature in 2m
- \circ td_2m: Dew-point in 2m
- thb_t : Thermal net flux at TOA
- o tmax_2m: Max 2m temperature
- o tmin_2m: Min 2m temperature
- tot_prec : Total precipitation
- o tqc : Total column integrated cloud water
- o tqi: Total column integrated cloud ice
- uv_10m: 10 meter wind intensity







Multilevel parameters considered (stored every 3hs over a domain constrained over Greece)

- o u: Zonal wind
- o v: Meridional wind
- w: Vertical velocity
- o temp: Temperature
- \circ pres: Presure
- \circ qv: specific humidity
- o qi: specific cloud ice content
- o qc: specific cloud water content







08

Some highlights of the results are presented below in reference to a snapsot of the Storm "Daniel", for September 5, 2023 12 UTC (model run d2023090400+36hs) regarding selected radiation fields and over the period September 4 to 7 2023 when Greece was mostly effected regarding accumulated precipitation.



Storm Daniel on 5 September 2023 https://en.wikipedia.org/wiki/Storm_Daniel





09

Surface Parameters considered:

- sob_s: Shortwave net flux at surface
- $\circ~$ sou_s: Shortwave upward flux at surface
- asob_t: TOA net solar radiation mean since model start
- athb_t: TOA net thermal radiation mean since model start
- $\circ~$ clcl: High level clouds
- clcm : Low level clouds
- $\circ~$ clch: Mid level clouds
- clct : Total cloud cover
- tot_prec : Total precipitation



Shortwave upward flux at surface (sou_s) [default (Tegen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

ΞΘΝΙΚΗ



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

Shortwave net flux at surface (sob_s) [default (Tegen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

<u>ONIKH</u>



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

(sou_s +sob_s) [default (Tegen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

EONIKH



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024



TOA net solar radiation mean since model start (asob_t) [default (Tegen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

εθνική



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024



TOA net thermal radiation mean since model start(athb_t) [default (Teggen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

εθνική

ΙΗΡΕΣΙΑ

delta_athb_t(W/m2) 00+36hs delta_athb_t(W/m2) 00+36hs IceOpt - default Demott - default 51N 48N 48N 45N 45 42N 42N 391 391 36N 36N 0 33N 33N 30N 30N 27N 271 ^{15E} 20E 25E 30E 3 delta_athb_t(W/m2) 00+36hs 15E 20E 25E 30E 3 delta_athb_t(W/m2) 00+36hs 10E 35E 4ÓE 5Ė 10E 4ÓE camsforc - default camsclim - default 451 45N 42 42N 39 -3. 36 36N 0 33N 33N 30N 30N 27N 271 ^{5E} W m-^{10E} -30 -20 -10 10 20 30 0

CONSORTIUM FOR SMALL SCALE MODELING

Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

EONIKH

(asob_t +athb_t) [default (Teggen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

EONIKH



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

Low level cloud cover (clcl) [default (Teggen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

EONIKH



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

Midle level cloud cover (clcm) [default (Teggen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

EONIKH



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

High level cloud cover (clch) [default (Teggen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024

EONIKH



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

S NO Total cloud cover (clcl) [defau



Total cloud cover (clcl) [default (Teggen)] 2023090512 UTC (00+36hs)



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM , Frankfurt-Offenbach, September 2-6, 2024



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024

24hr accumulated precipitation (tot_prec) [default (Teggen)] 2023090418-2023090518 UTC

0.1

0.2

0.5



ΞΘΝΙΚΗ



Euripides Avgoustoglou, Hellenic National Meteotological Service, 26th COSMO GM, Frankfurt-Offenbach, September 2-6, 2024





EONIKH





33

EONIKH





34

EONIKH





35

EONIKH





36

EONIKH





EONIKH





38

EONIKH

ΤΗΡΕΣΙΑ





39

EONIKH

ΤΗΡΕΣΙΑ





40

EONIKH

ΓΙΗΡΕΣΙΑ



EONIKH

ΤΗΡΕΣΙΑ

41







42

CONCLUSIONS AND PROSPECTS

- The task regarding the production of data was accomplished for a whole year, a significant extension over the initial consideration for two months (January and July) providing a seasonably complete set.
- Considerable differences were addressed regarding the extreme weather case that was selected.
- The challenge to systematically investigate this set in reference to radiation is pending but is expected to provide a significant insight into the understanding of aerosol climatologies.
- The inclusion of synoptic fields to this data production provides an excellent opportunity to evaluate the impact of different aerosol climatologies to the exceptional weather complexities of the Central-Eastern Mediterranean.
- The challenging results regarding precipitation over an extreme weather effect added value to the above and motivate the investment of further efforts.