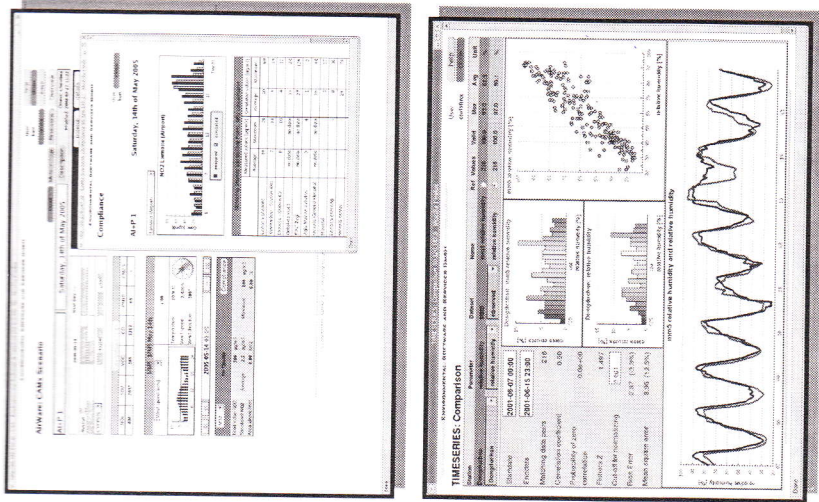


3. Test Application Examples

Within the international EUREKA E13266 WEBAIR development project (<http://www.ess.co.at/WEBAIR>), several parallel test cases are used to develop and validate the system. They include:

the Island Republic of Cyprus and a several urban scale case studies including Limassol. Cyprus has comparatively low emissions, but complex meteorology due to its island nature; the Korean peninsula, with a central case study of Seoul metropolitan area and the surrounding heavily industrialized province Gyeonggi-do; the Greater Tehran Area around the capital city of Iran, a case that is dominated by traffic sources; the industrial city of Sisak in Croatia; and selected industrial development zones along the Arabian Gulf, United Arab Emirates. Experiments with real-time data assimilation are just starting, but the comparison with historical data shows very good correspondence of model results with observational data for both meteorological and photochemical air quality model results.

The on-line pilot systems and operational forecasts are accessible from <http://www.ess.co.at/DEMOS#air>, and the WEBAIR and AirWare project sites: <http://www.ess.co.at/WEBAIR> and <http://www.ess.co.at/AIRWARE>



4. Questions and Answers

Peter Bultjes: Did you consider improving your air quality forecasting by improving – trying – the emission “forecasting”?

Kurt Fedra: Yes, we try to tune both the temporal patterns used (analyzing the residuals) as well as for individual monitoring stations where the wind-direction dependent contributions can be well identified (apportionment) by adjusting sectoral emission scaling factors if the bias is “consistent”.

2.5 Sea-Salt Aerosol Forecasts over the Mediterranean Sea

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Abstract Numerical simulations of sea-salt aerosol (SSA) over the Mediterranean were conducted and compared with sea-salt ground-based measurements taken at the following three sites: Barcelona, Spain, a 2-year data set (2006–2007); Tel-Aviv, Israel, from March 12 to April 9, 2006; and Finokalia, Crete, Greece, from May 2 to 30, 2008. The comparison showed that the model was capable of producing reasonable sea-salt concentrations. We found that specific features of the monitoring site located over the land could contribute to some discrepancy between model data and measurements. In summer, the model underestimated SSA-measurements when actual sea-wave height did not correspond to observed surface sea winds. In winter, winds which do not blow from sea to land create sea-salt aerosols over the sea in the vicinity of Barcelona: these aerosols are not transported inland. Under these circumstances, the model overestimated sea-salt measurements.

1. Introduction

SSA scatters solar radiation and thereby plays an important role in the atmospheric radiation budget. Acting as cloud condensation nuclei, sea-salt could affect cloud formation in the marine boundary layer. The Mediterranean Sea is of specific interest as it is a crossroad where natural aerosols and anthropogenic aerosols from different sources are superimposed. Because of the lack of in situ ground-based sea-salt measurements, model-based 24-h forecasts of SSA could be helpful, providing valuable information about space and time distributions of sea-salt aerosols in the Mediterranean region. This study was aimed at comparing quantitatively model-predicted sea-salt aerosol concentrations with sea-salt ground-based

measurements at the following three Mediterranean sites: Barcelona, Spain; Tel-Aviv Israel; and Finokalia, Crete, Greece. It is known from previous studies that there are some discrepancies between model data and SSA-measurements. We found that specific features of the monitoring sites, located over the land, could contribute to the discrepancies between model data and measurements. The full description of this study has been previously submitted for publication to the Journal of Geophysical Research (Kishcha et al., 2009).

2. Methodology

Numerical simulations of the sea-salt aerosols were conducted using the first version of the DREAM-Salt prediction model. This model is based on the DREAM dust aerosol model (Nickovic et al., 2001), which was adapted to function not only for mineral dust but also for sea salt aerosols (Nickovic et al., 2007). In operational use in Tel-Aviv University, DREAM-Salt produces daily forecasts of 3-D distribution of sea-salt aerosol concentration over the Mediterranean model domain 20W–45E, 15N–50N (<http://wind.tau.ac.il/salt-ina/salt.html>). The model has 0.3° horizontal resolution, and 24 vertical levels. Forecasts are made once every day, starting from the 12:00 UTC objective analyses and providing forecasts up to 72 h ahead. The NCEP/Eta regional atmospheric model (Janjic, 1994) drives the aerosol. The aerosol emission scheme is based on the viscous sub-layer model (Janjic, 1994), in which energy and mass transfers above the air-sea interface critically depend on turbulent conditions. The aerosol concentration at the top of the viscous sub-layer is used as the lower boundary condition. The sea-salt emission scheme defines the lower boundary condition using the source function of Erickson et al. (1986). Eight particle categories with sizes ranging from 1 to 8 µm are used in the model. DREAM-Salt incorporates parameterizations of all other major phases of atmospheric sea-salt aerosol life such as: diffusion, advection, gravitational settling, and wet removal of sea-salt aerosols (Nickovic et al., 2001).

In Barcelona, the sea-salt measurements were taken 2 days/week during the 2-year period, 2006–2007. In Tel-Aviv, a special sampling campaign was arranged, which resulted in the collection of sea salt measurements from March 12 to April 9, 2006. Both in Barcelona and in Tel-Aviv, samples were collected over 24 h with the usual start time of 0900 LT. In Finokalia, Crete, 6-h-averaged measurements were taken from May 2–30, 2008.

3. Results and Discussion

Shown in Fig. 1a, a model-vs.-measurements comparison in Finokalia shows similarities between model data and 6-h measurements. Some overestimation can be partly explained by the fact that, in the sea, sea-salt aerosols are produced under

any wind direction. However, sea-salt transport inland, to the monitoring site, depends on a specific wind component directed from sea to land. Because of coarse resolution, the model produced the same sea-salt concentration over the monitoring site as over the adjacent sea area. This is correct for all sites located over the land, except for those located at very small islands.

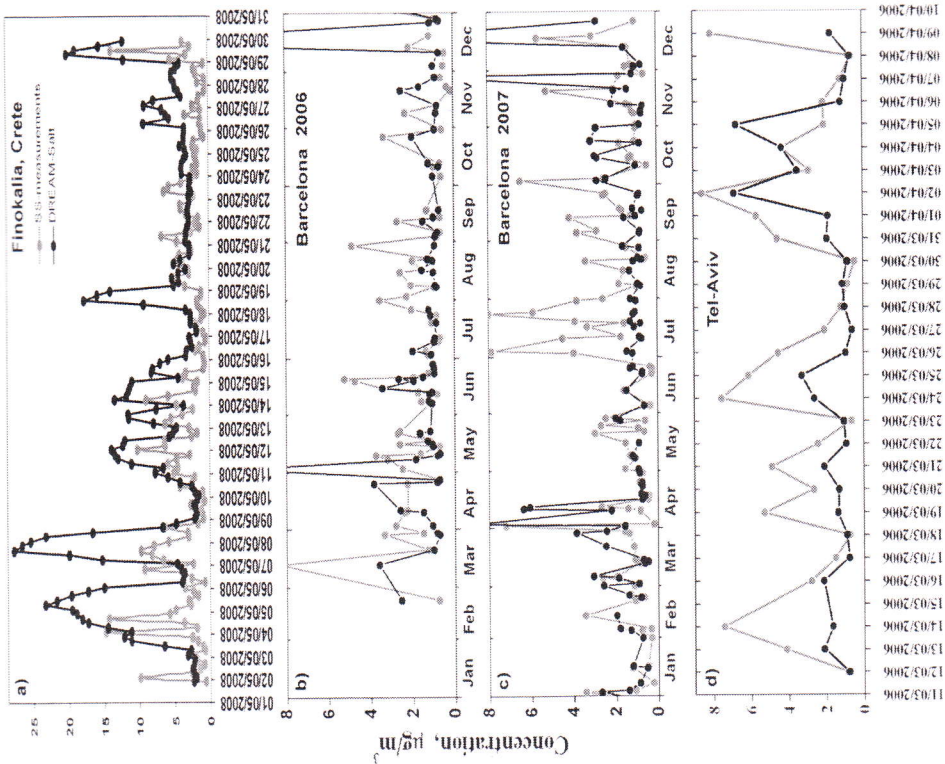


Fig. 1. Comparison between modeled sea-salt concentrations (the black lines) and measurements (the grey lines) in (a) Finokalia, Crete, (b,c) Barcelona, Spain, and (d) Tel-Aviv, Israel (Adapted from Kishcha et al. (2009))

The model-vs.-measurement comparison in Barcelona showed that for the majority of days, the model produced quite realistic sea-salt concentrations (Fig. 1b and c). An average simulated aerosol concentration ($\pm$ standard deviation) ranged within the same interval as the measurements did $2 \pm 2 \mu\text{g}/\text{m}^3$. The relatively high standard deviation indicates strong variability of sea-salt aerosol concentrations

due to strong variability of wind speed and wind direction. Although sometimes the model fit measurements quite well, a correlation between model data and measurements in Barcelona over the 2 year period, 2006–2007, was rather low (~ 0.2). Possible reasons for the discrepancy are discussed in detail by Kishcha et al. (2009). In particular, it was found that specific features of the chosen monitoring site could contribute to low correlation between model data and measurements. In summer, the model underestimated SSA-measurements when actual sea-wave height did not correspond to observed surface sea winds. In winter, winds which do not blow from sea to land create sea-salt aerosols over the sea in the vicinity of Barcelona: these aerosols are not transported inland. Under these circumstances, the model overestimated sea-salt measurements.

In contrast to Barcelona, Tel-Aviv is located on the east coast of the Mediterranean and is not surrounded by mountains. The direction of sea-salt aerosol transport from sea to land is the same as the direction of prevailing winds, from west to east. So it is much easier to predict SSA in Tel-Aviv than in Barcelona. As seen in Fig. 1d, some similarity exists between model data and measurements. The averaged measured SSA concentrations over the sampling period ranged within approximately the same intervals: $3 \pm 3 \mu\text{g}/\text{m}^3$ for measurements and $2 \pm 2 \mu\text{g}/\text{m}^3$ for model data. We found (Kishcha et al., 2009) that model errors are mainly positive, indicating that the model tends to underestimate observations. A possible reason is that the model does not take into consideration SSA which is produced by breaking waves in the surf zone.

Acknowledgements We gratefully acknowledge B. Starobinets for helpful discussion. This study was supported by the BMBF (Germany) – MOST (Israel) grant number 1946 on global change.

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4. Questions and Answers

A. Kerschbaumer: Did you take into account deposition processes in the model?

Answer: Both gravitation settling and wet removal of sea-salt aerosols were included in the model. Our analysis of sea-salt measurements in Finokalia, Crete, shows that southerly winds, blowing across the island, do not contribute to sea-salt measurements at the monitoring site due to sea-salt deposition (Kishcha et al., 2009). In particular, we detected that the majority of sea-salt aerosols was not transported over land more than 50–60 km under moderate surface wind speeds ~ 7 m/s. In accordance with model sea-salt simulations in Tel-Aviv, under summer light breeze conditions with surface wind speeds less than 4 m/s, the majority of SSA is transported up to 30 km inland. During the transit of cyclones across the Mediterranean, when surface wind speeds exceed 10 m/s, sea-salt aerosols could be transported over ~ 70 km.

J. Casares: Was any work done on size distributions of sea-salt measurements?

Answer: A detailed set of eight particle size classes with effective size between 1 and $8 \mu\text{m}$ (1, 2, 3, 4, 5, 6, 7, and $8 \mu\text{m}$) was used in our model.

M. Astitha: Sea-salt aerosol production depends on relative humidity, especially with respect to the size distribution of generated aerosols. Was that taken into account in your emission scheme?

Answer: In the current study, we used a sea-salt model with no dependence of sea-salt production on relative humidity. The purpose of our study was to demonstrate that specific features of the chosen monitoring site located over the land could contribute to some discrepancy between model data and measurements, no matter how sophisticated the sea-salt source function is. In the future, our sea-salt forecasts may be further improved on sea-salt hygroscopic properties.

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