



## Model Evaluation

Statistic Parameter	Formula	Range	Perfect Score
Correlation Coefficient (r)	$r = \frac{\sum_{i=1}^n (c_i - \bar{c})(o_i - \bar{o})}{\sqrt{\sum_{i=1}^n (c_i - \bar{c})^2} \sqrt{\sum_{i=1}^n (o_i - \bar{o})^2}}$	-1 to 1	1
Fractional Gross Error (FGE)	$FGE = \frac{2}{n} \sum_{i=1}^n \frac{ c_i - o_i }{ c_i + o_i }$	0 to 2	0
Mean Bias Error (MBE)	$MBE = \frac{1}{n} \sum_{i=1}^n (c_i - o_i)$	$-\infty$ to $+\infty$	0
Root Mean Square Error (RMSE)	$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (c_i - o_i)^2}$	0 to $+\infty$	0

**The correlation coefficient (r)** indicates the extent to which patterns in the model match those in the observations. The correlation coefficient ranges from -1.0 to +1.0

**The fractional gross error (FGE)** is a measure of model error, ranging between 0 and 2 and behaves symmetrically with respect to under- and overestimation, without over-emphasizing outliers.

**The mean bias error (MBE)** captures the average deviations between two datasets. It has the units of the variable. Values near 0 are the best, negative values indicate underestimation and positive values indicate overestimation.

**The root mean square error (RMSE)** combines the spread of individual errors. It is strongly dominated by the largest values, due to the squaring operation. Especially in cases where prominent outliers occur, the usefulness of RMSE is questionable and the interpretation becomes more difficult.



## The ECMWF Copernicus Atmosphere Monitoring Service (CAMS)

<https://atmosphere.copernicus.eu/>



Managed by ECMWF on behalf of the EU, the Copernicus Atmosphere Monitoring Service (CAMS) provides policy makers, businesses, scientists and the general public with reliable information about the composition of our atmosphere and how it is changing.



### AIR QUALITY AND ATMOSPHERIC COMPOSITION

European air quality analyses, forecasts and assessments in support of reporting and policy making, pollen forecasts, global transport of constituents/pollutants...



### CLIMATE FORCING

Distributions of aerosol components and their radiative impacts, other radiative forcings...



### OZONE LAYER AND UV

Monitoring and forecasting of the ozone layer / hole, UV index, UV radiation (crops, ecosystems)...



### SOLAR RADIATION

Estimates of solar irradiance at surface, improved potential yield assessments for solar plants...



### EMISSIONS AND SURFACE FLUXES

Estimates of human emissions globally and in Europe (high-resolution), emissions by wildfires, surface fluxes of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O...

## ECMWF-CAMS model characteristics:

<b>Institution</b>	ECMWF	<b>Vertical resolution</b>	137 sigma-layers
<b>Meteorological driver</b>	ECMWF-IFS	<b>Height of first layer</b>	10 m a.g.l.
<b>Coverage</b>	Global	<b>Radiation interactions</b>	No
<b>Emission scheme</b>	Uplifting (Ginoux et al., 2001; Morcrette et. al., 2008, 2009)	<b>Transport size bins</b>	3 bins (0.03-20 $\mu$ m)
<b>Horizontal resolution</b>	8-10 km approx. (O1280)	<b>Data assimilation</b>	Yes (AOD550/MODIS)



## Domains

The area of interest is bounded by the following coordinates:

Domain	Lat. (N)	Lon. (E)
West Asia	10 - 50	20 - 80
Turkey	36 - 42	26 - 45
North-Eastern Africa	10 - 36	20 - 36
Middle East	15 - 39	35 - 65
Central Asia	15 - 50	25 - 80

