Relationship Between Wind Speed and Aerosol Optical Depth over Remote Ocean

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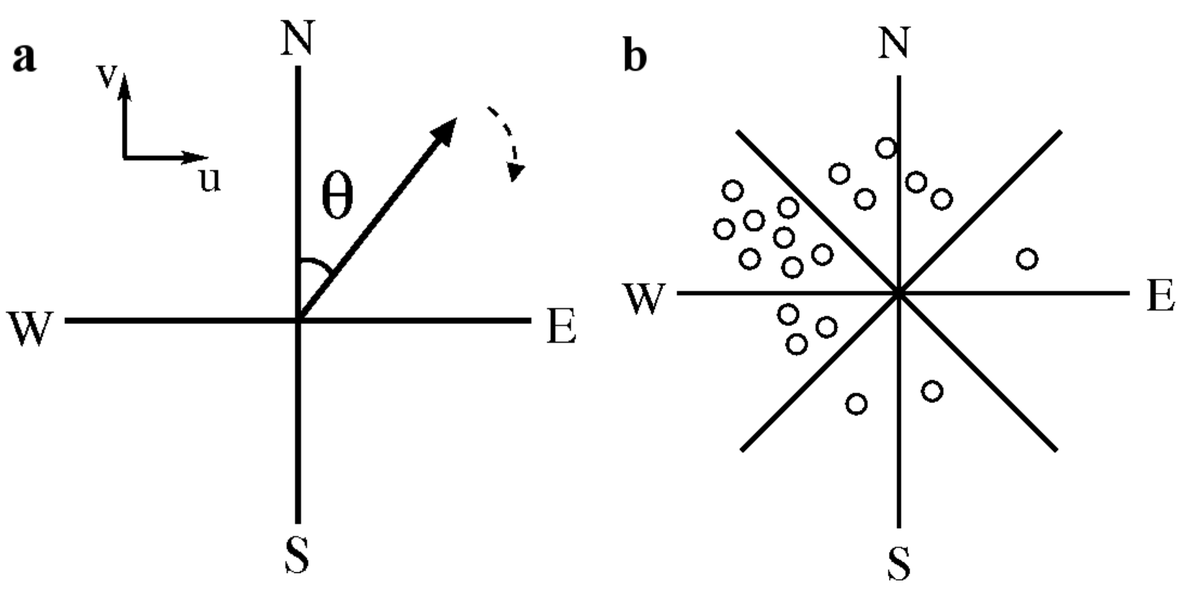
Abstract Remote ocean regions are defined by the combination of aerosol optical depth (AOD) from satellite observation and wind direction from ECMWF. According to our definition, many oceanic regions can not be taken as remote ocean regions due to long range transportation of aerosols from continents. Highly correlated linear relationships are found in remote ocean regions with a wind speed range of 4-20 m/s. The enhancement of AOD at high wind speed is explained as the increase of sea salt aerosol production.

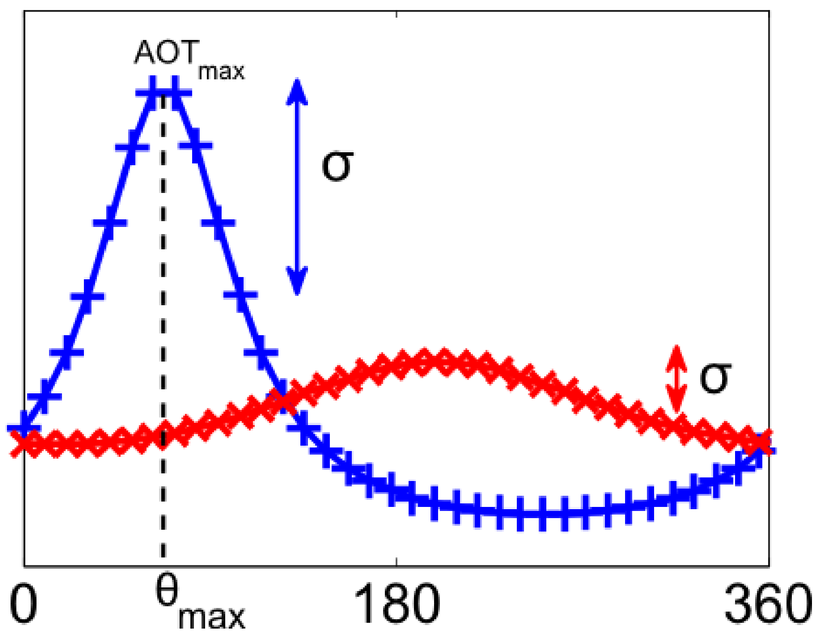
Introduction Aerosols are the main contributor to light scattering in the cloud-free atmosphere in remote oceanic regions with marine atmosphere. They also participate in cloud processes, serving as the dominant cloud condensation nuclei (CCN) source. On the other hand, the background sea salt aerosol is important to understanding the atmospheric radiative budget.

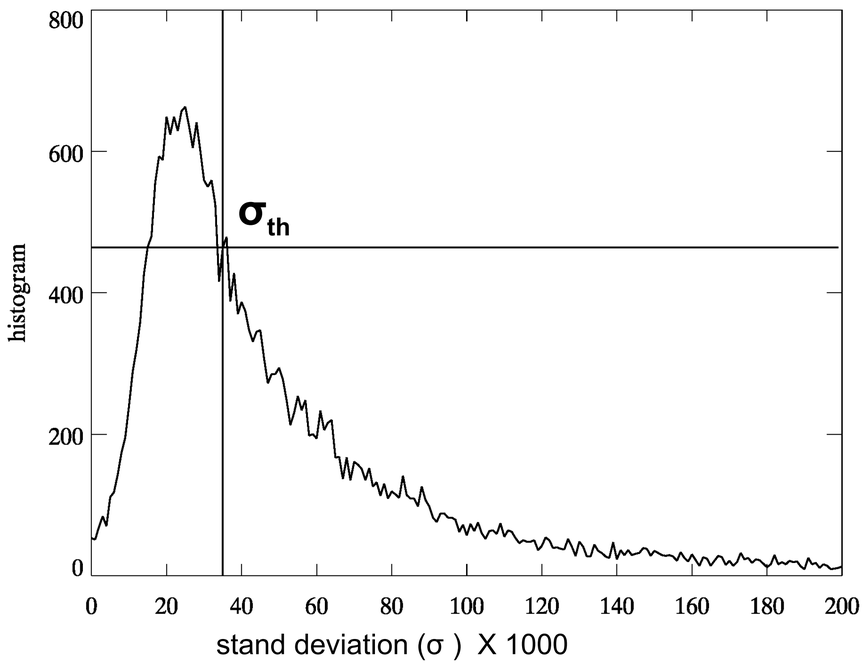
Data *Aerosol data* were the aerosol optical depth at 550 nm, retrieved from Advanced Along-Track Scanning Radiometer (AATSR) as part of the ESA Globaerosol Project.

Wind data is obtained from ECMWF with spatial resolution 1x1, on the same grid of the *aerosol data*. For each point the daily wind data are sorted into different bins according to the corresponding wind direction.



Remote Ocean Identification



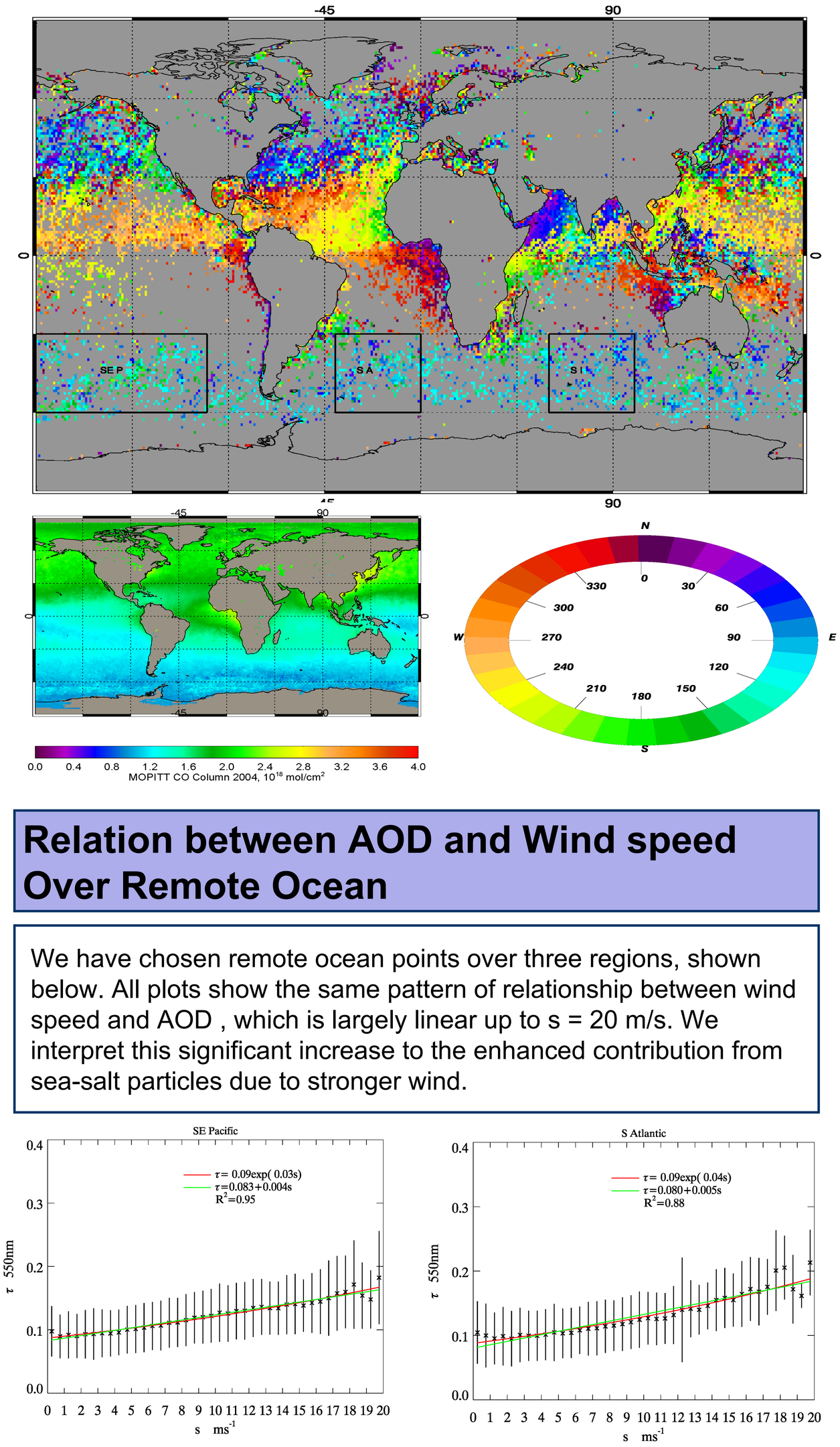


For truly remote oceanic regions, only aerosol source is the ocean and thus the AOD should not depend on wind direction but only wind speed and other parameters like temperature. We then calculate the standard deviation of AOD for all wind directions.
On the left, red line is the typical variation in remote ocean region while blue line means significant influence from continents.

We chose 2/3 of the peak values of histogram of σ to be the threshold to check remote ocean region

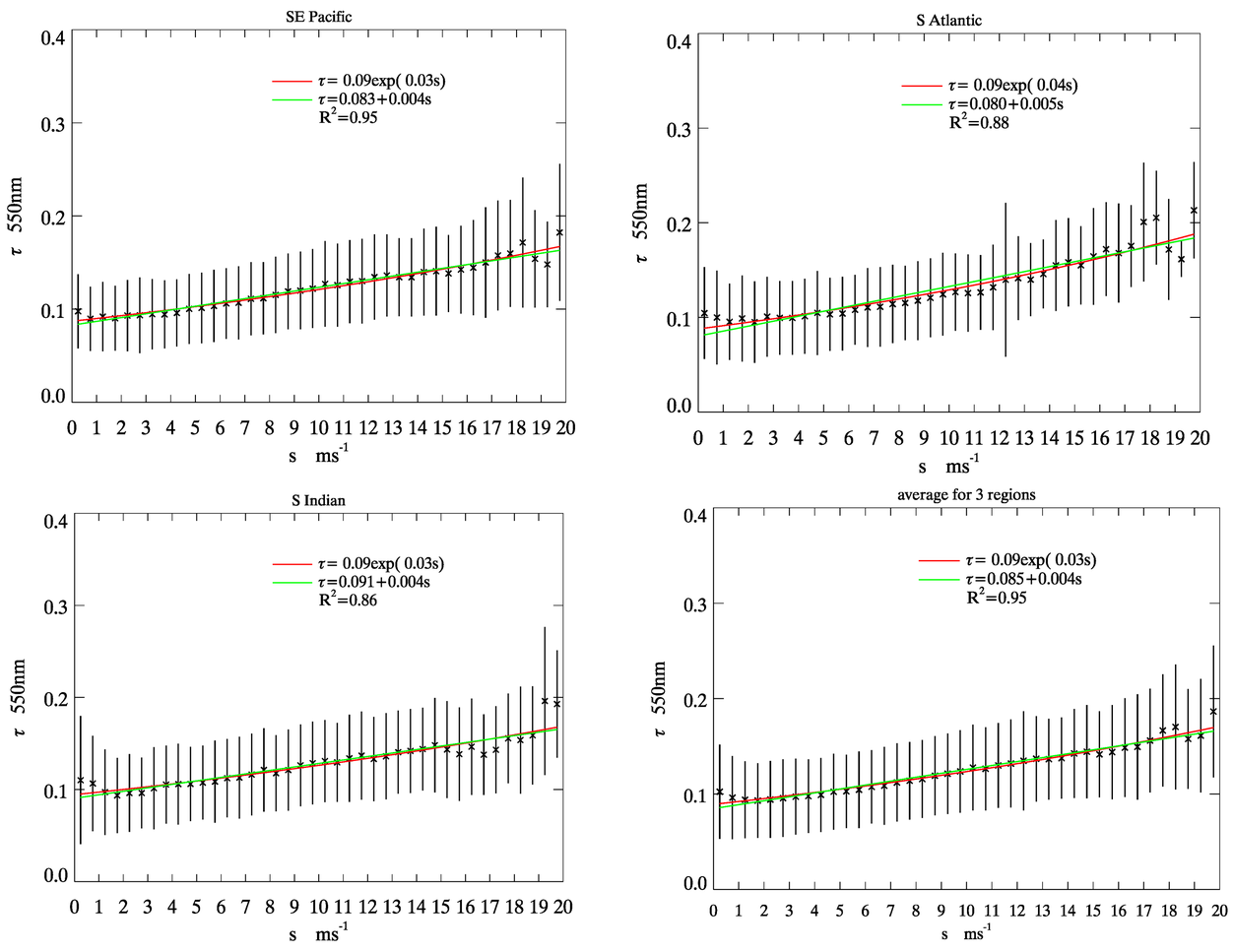
Global Remote Ocean Characterization

For the points where σ is greater than σ_{th} , the corresponding angle in which the averaged AOD is maximum, is shown below. This map roughly matches the large-scale flow field and storm tracks. Many regions, especially in the northern hemisphere, could not be regarded as pure remote oceans. This result is supported by the carbon monoxide (CO) distribution map from Measurements Of Pollution In The Troposphere (MOPITT).



Relation between AOD and Wind speed Over Remote Ocean

We have chosen remote ocean points over three regions, shown below. All plots show the same pattern of relationship between wind speed and AOD , which is largely linear up to s = 20 m/s. We interpret this significant increase to the enhanced contribution from sea-salt particles due to stronger wind.



References

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