Assessment of dust source contribution to the land and ocean regions

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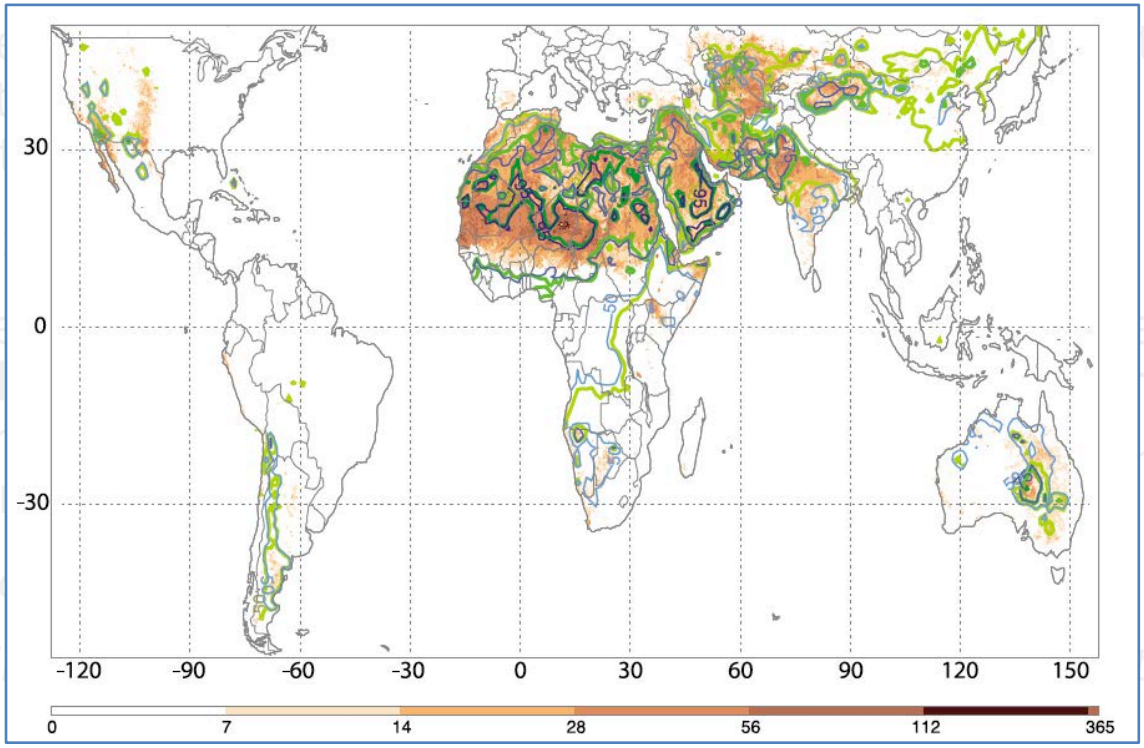
September 25, 2019, AeroCom meeting, Barcelona, Spain

Background

- The source of global dust is well established that most of them are originated from a few major source regions including North Africa, Middle East, and Asia which accounting for more than 80% of global dust emission.



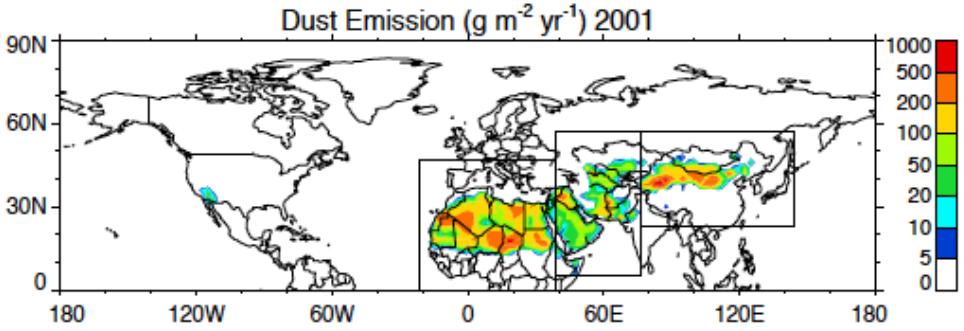
Dust source from MODIS and TOMS (Ginoux et al., 2012)

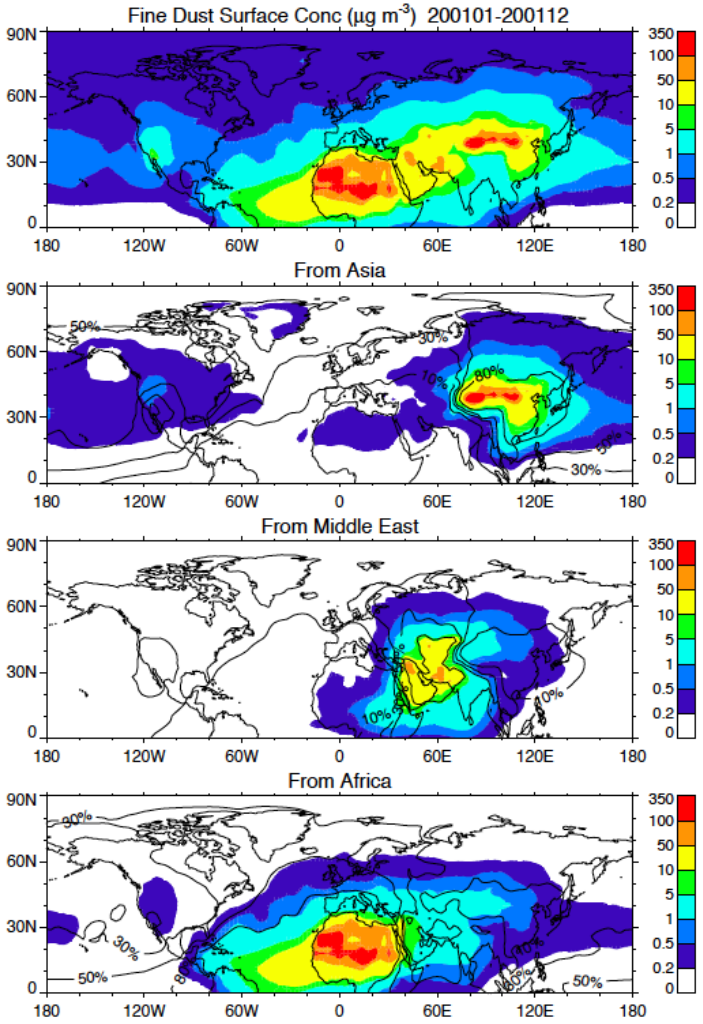
Background

- The source of global dust is well established that most of them are originated from a few major source regions including North Africa, Middle East, and Asia which accounting for more than 80% of global dust emission.
- However, attributing the source of dust in the Earth system is more difficult, since dust experiences complex atmospheric processes during the long-range transport.
  - horizontal-, vertical-advection, wet deposition, and dry deposition.
- Using NASA GEOS model, this work will investigate the source-receptor relationships in : (1) land regions, where affected by both local and transported dust, and (2) remote regions where only contributed by long-range transport.

  1) *North America, Europe, India, East Asia*
  2) *Amazon, Tibetan Plateau, Mid-Pacific* Ocean, *Arctic, and Antarctic*

Source identification by “tagging” source region

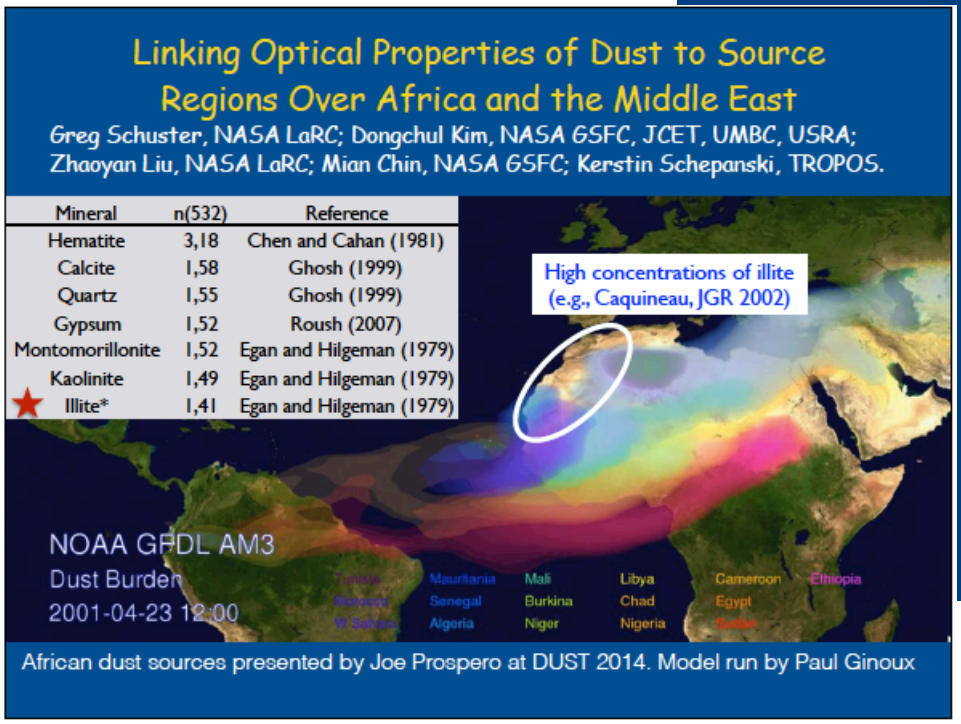


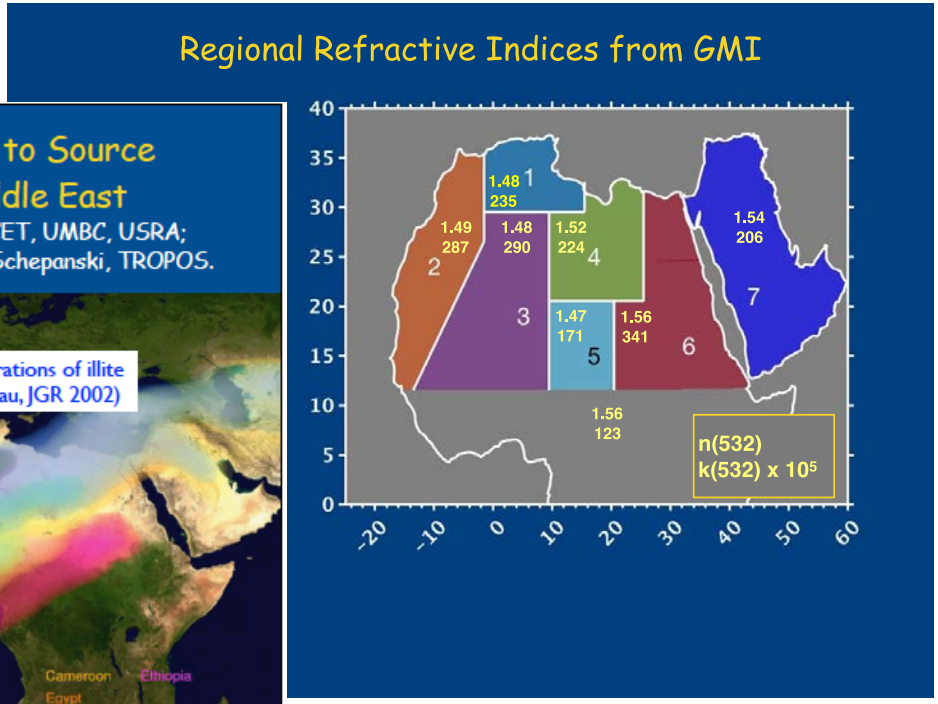


- GOCART model
- 3 tagged regions
- Study air quality: surface PM25 and vertical profile.
- Africa and Asia display a significant influence over large areas in the northern hemisphere including the Pacific ocean.

(Chin et al., 2007)

Source identification by “tagging” source region

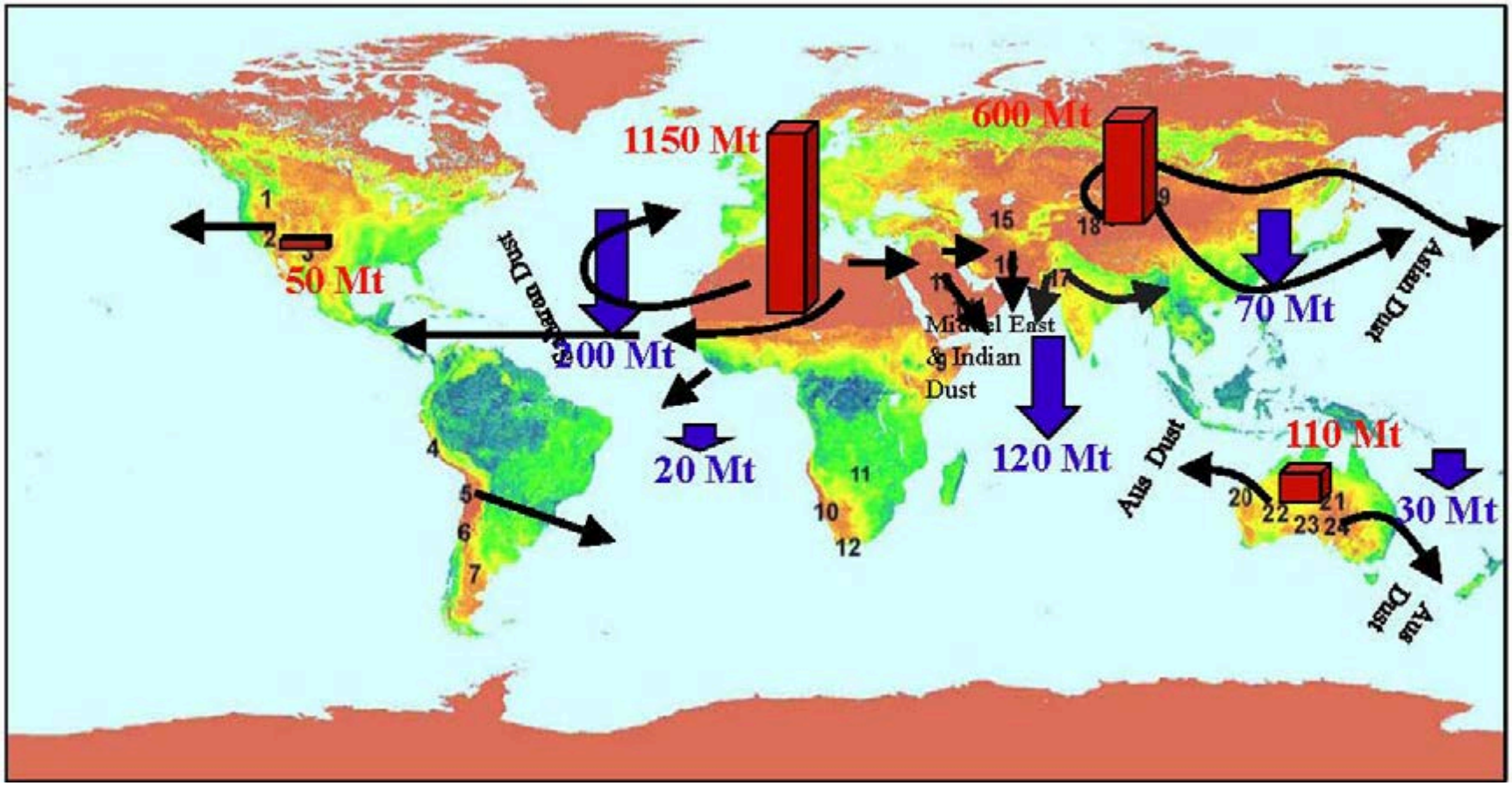




(Schuster et al., 2018)

- GEOS model
- 7 tagged source regions over North Africa
- Study the impact of soil mineralogy on dust optical properties.

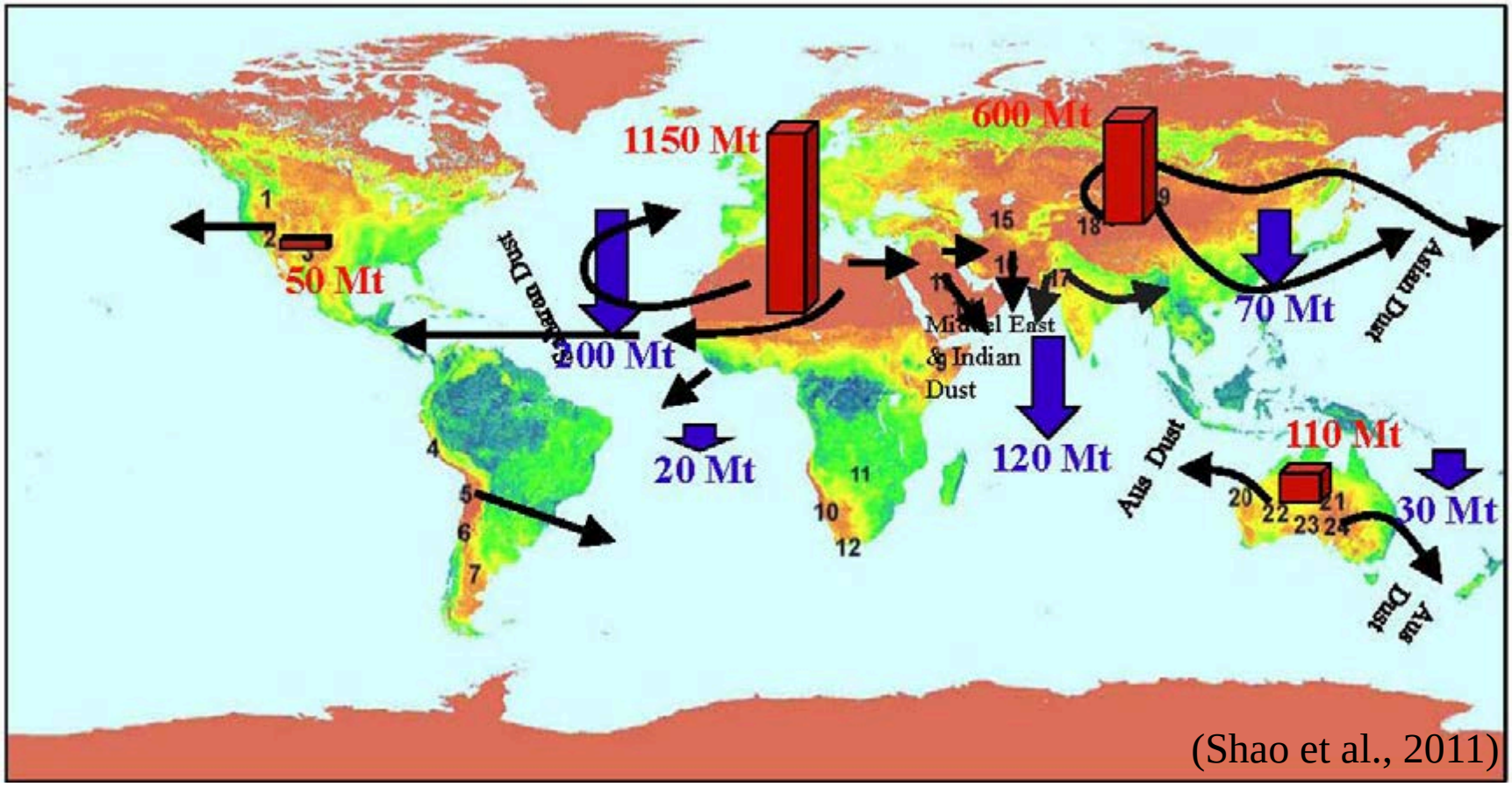
Where are dust from and where they go?



(Shao et al., 2011)

How can we further improve the current understanding?

1. Update estimate and uncertainty from AeroCom models
2. Study source-receptor relationships



(Shao et al., 2011)

8 tagged source regions

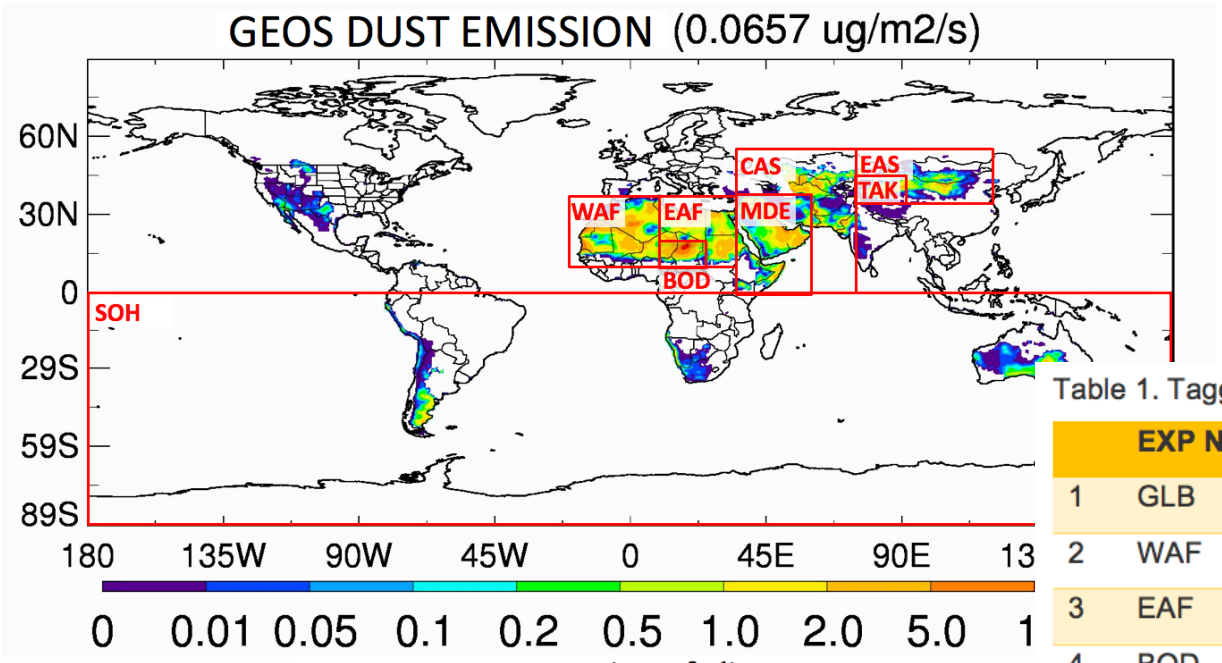
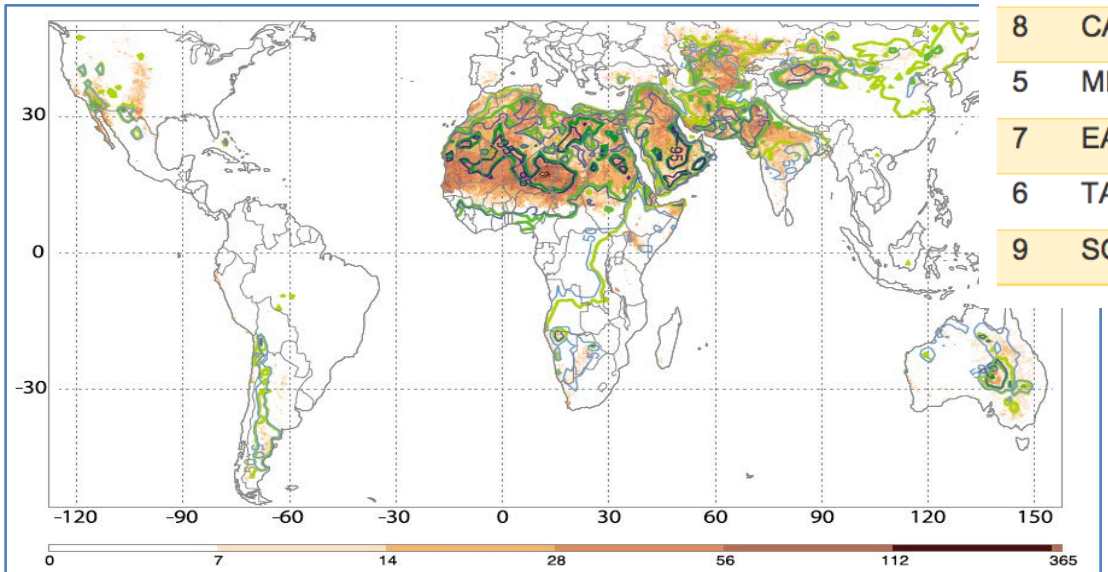
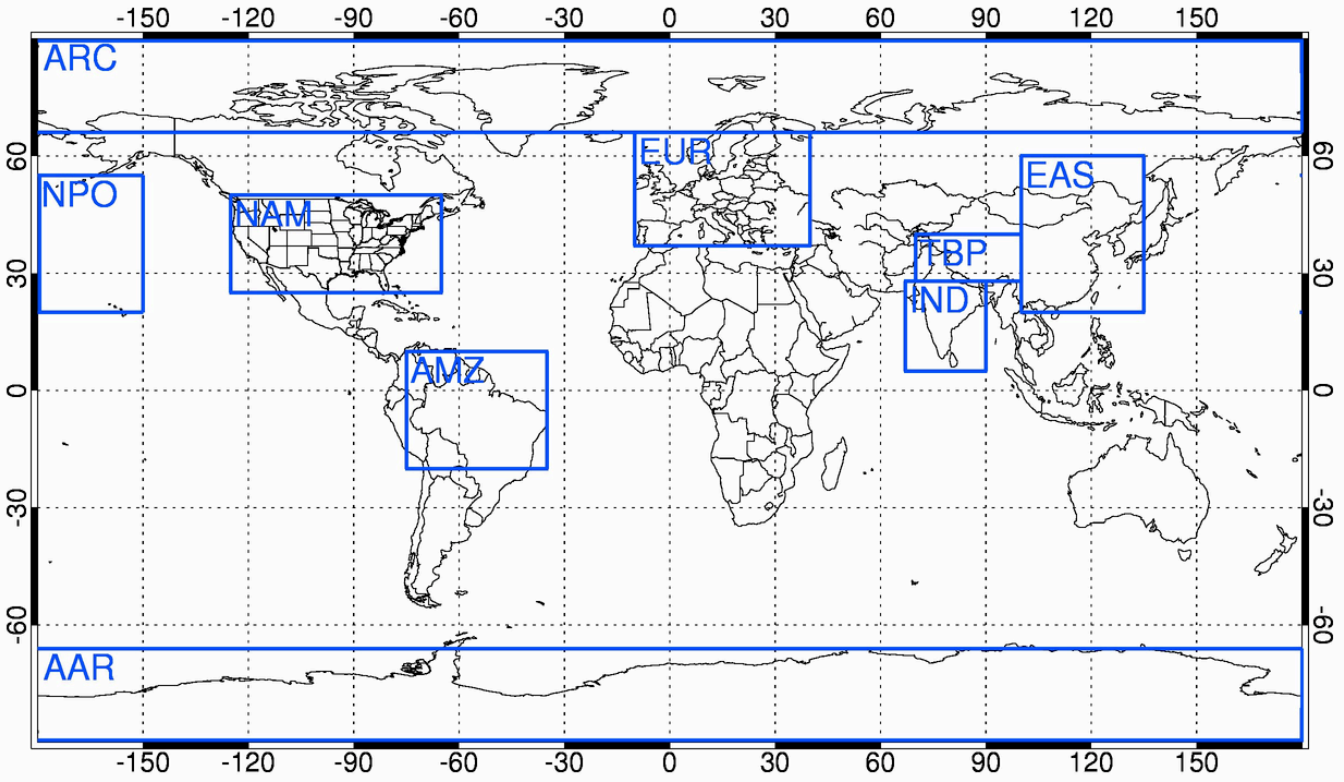


Table 1. Tagged region setup for the eExperim

	EXP Name	Tagged Region
1	GLB	Global
2	WAF	West Africa
3	EAF	East Africa
4	BOD	Bodele
8	CAS	Central Asia
5	MDE	Middle East
7	EAS	East Asia
6	TAK	Taklimakan Desert
9	SOH	Southern Hemisphere

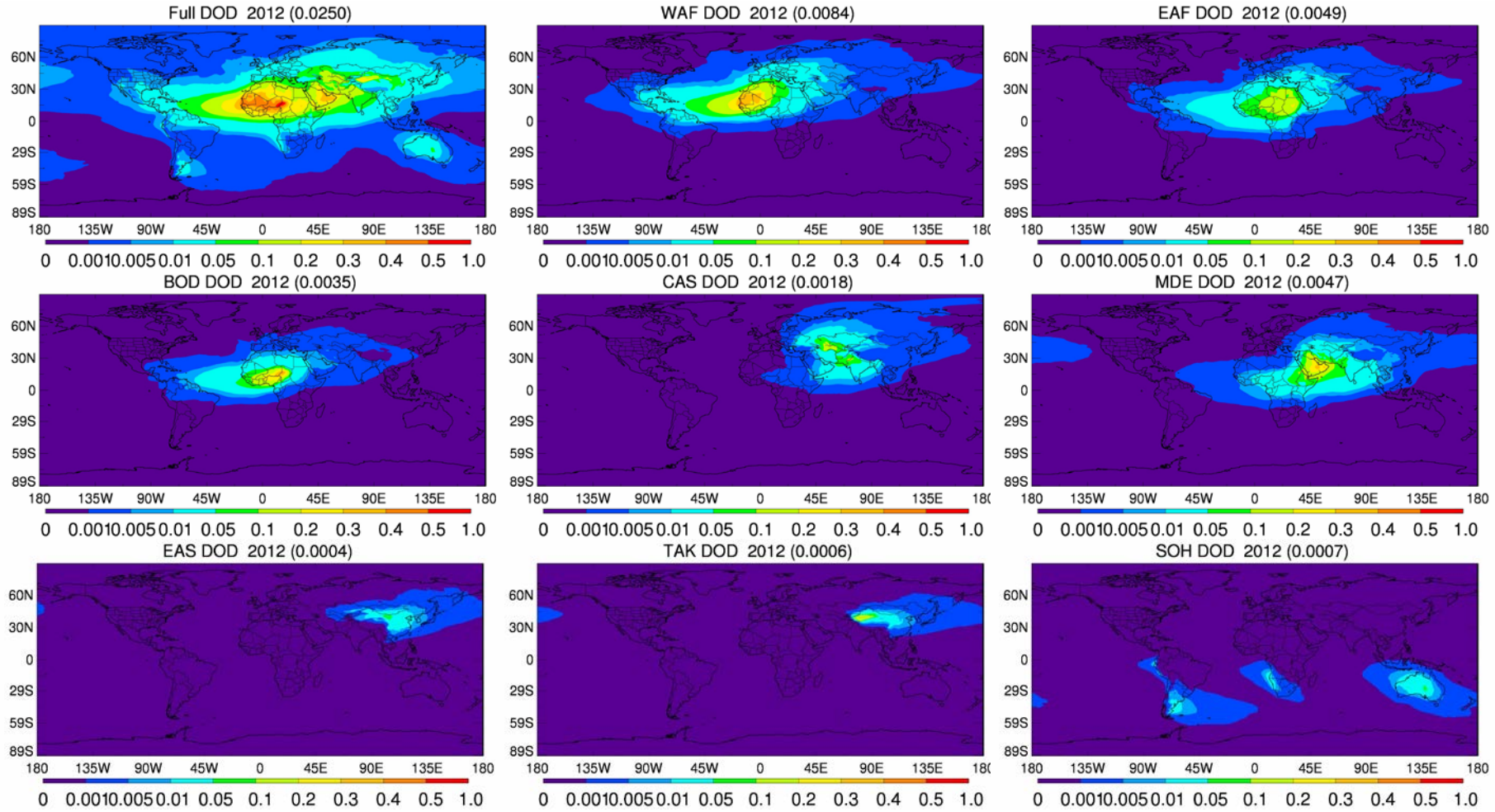


9 receptor regions

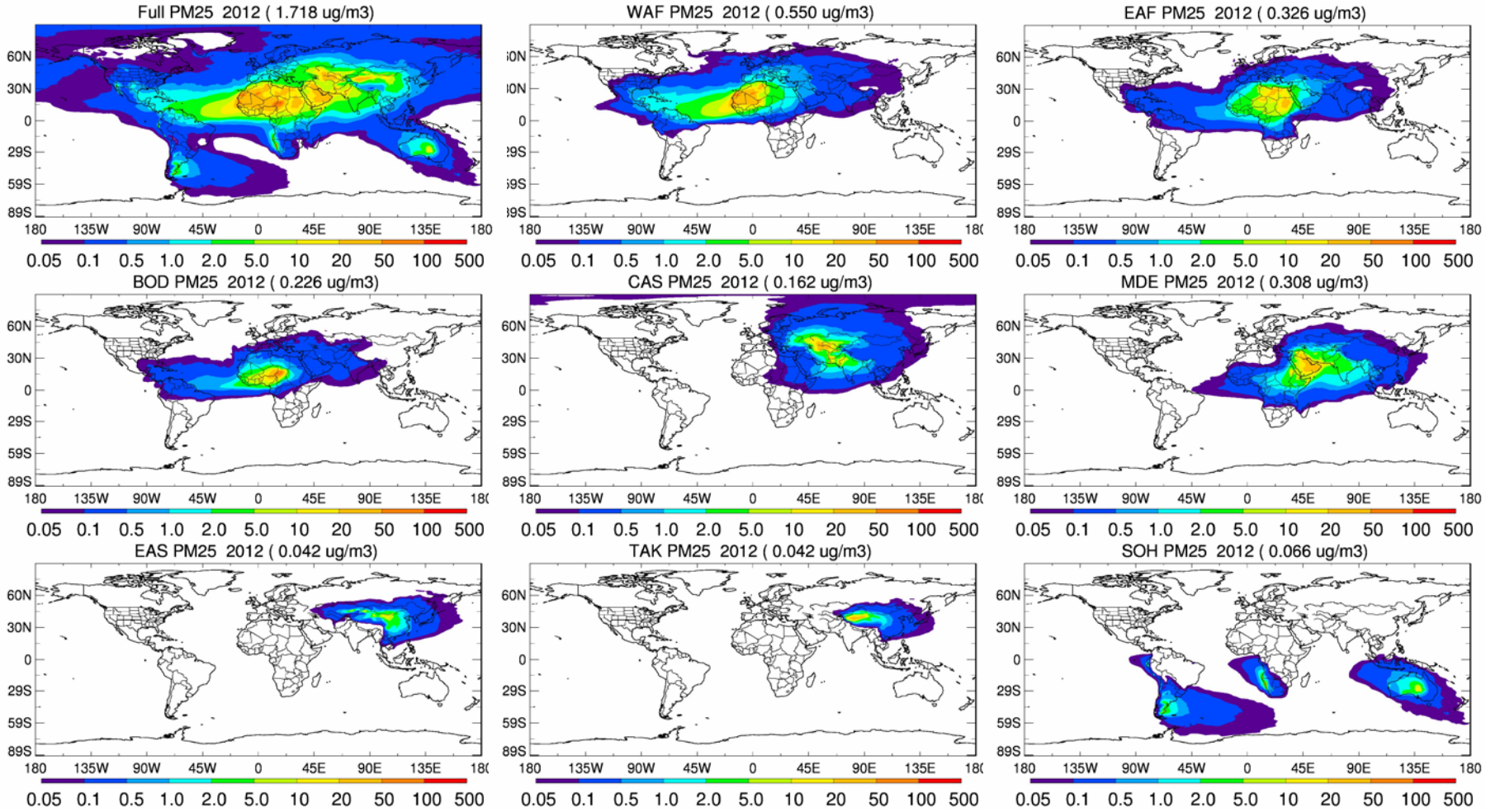


- *North America, Europe, India, East Asia*
- *Amazon, Tibetan Plateau, Norrhwen Pacific* Ocean, *Arctic, Antarctic*

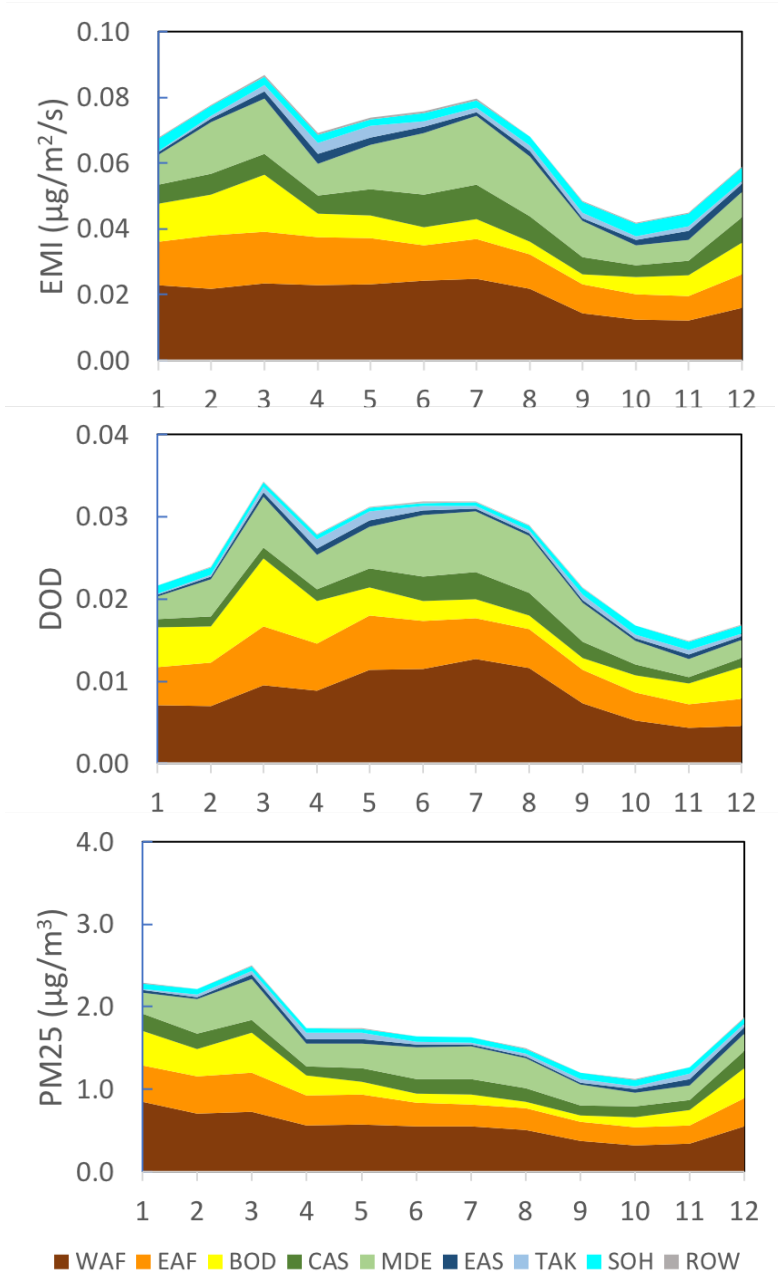
Annual mean of DOD in 2012

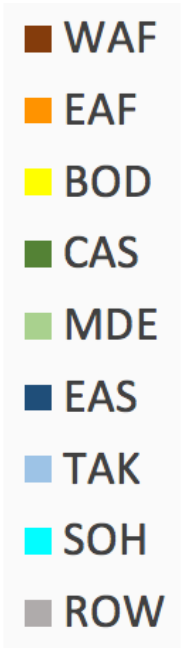


Annual mean of PM2.5 in 2012



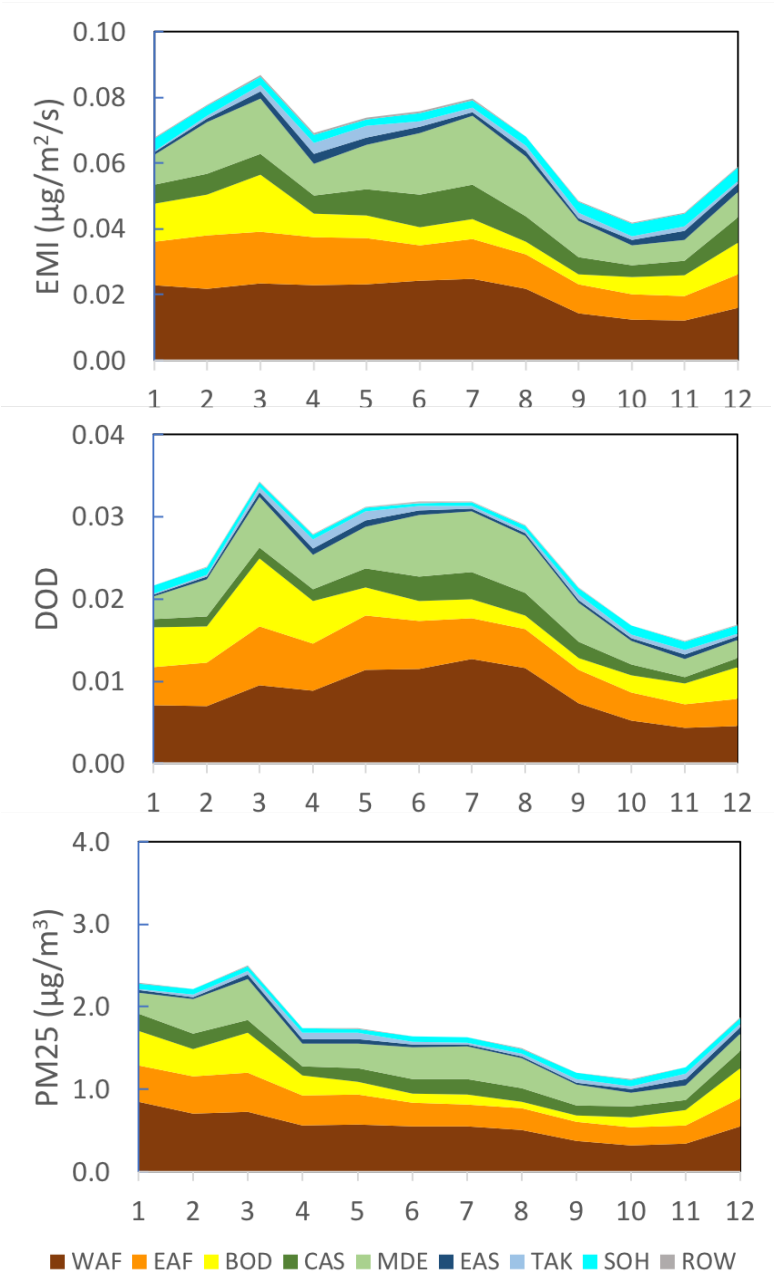
Global mean monthly values

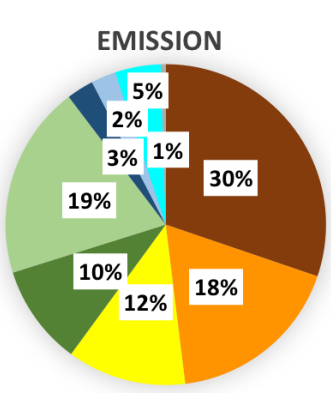


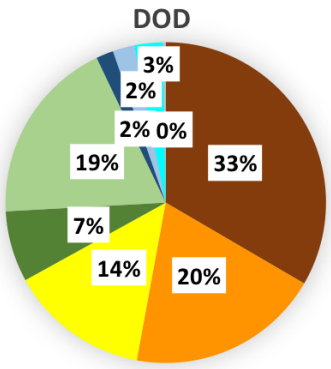


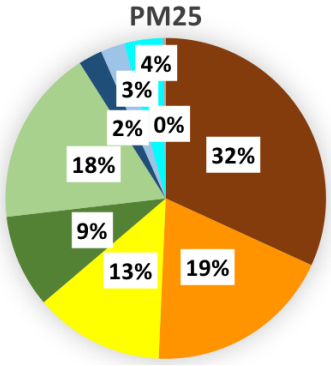
- North Africa is most dominant.
- For EMI and DOD, there are strong seasonality with an high in Jan-Aug.
- PM25 has an high in winter.

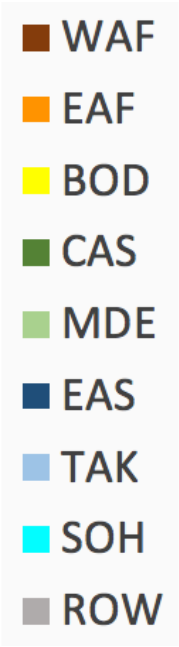
Global mean monthly and annual values





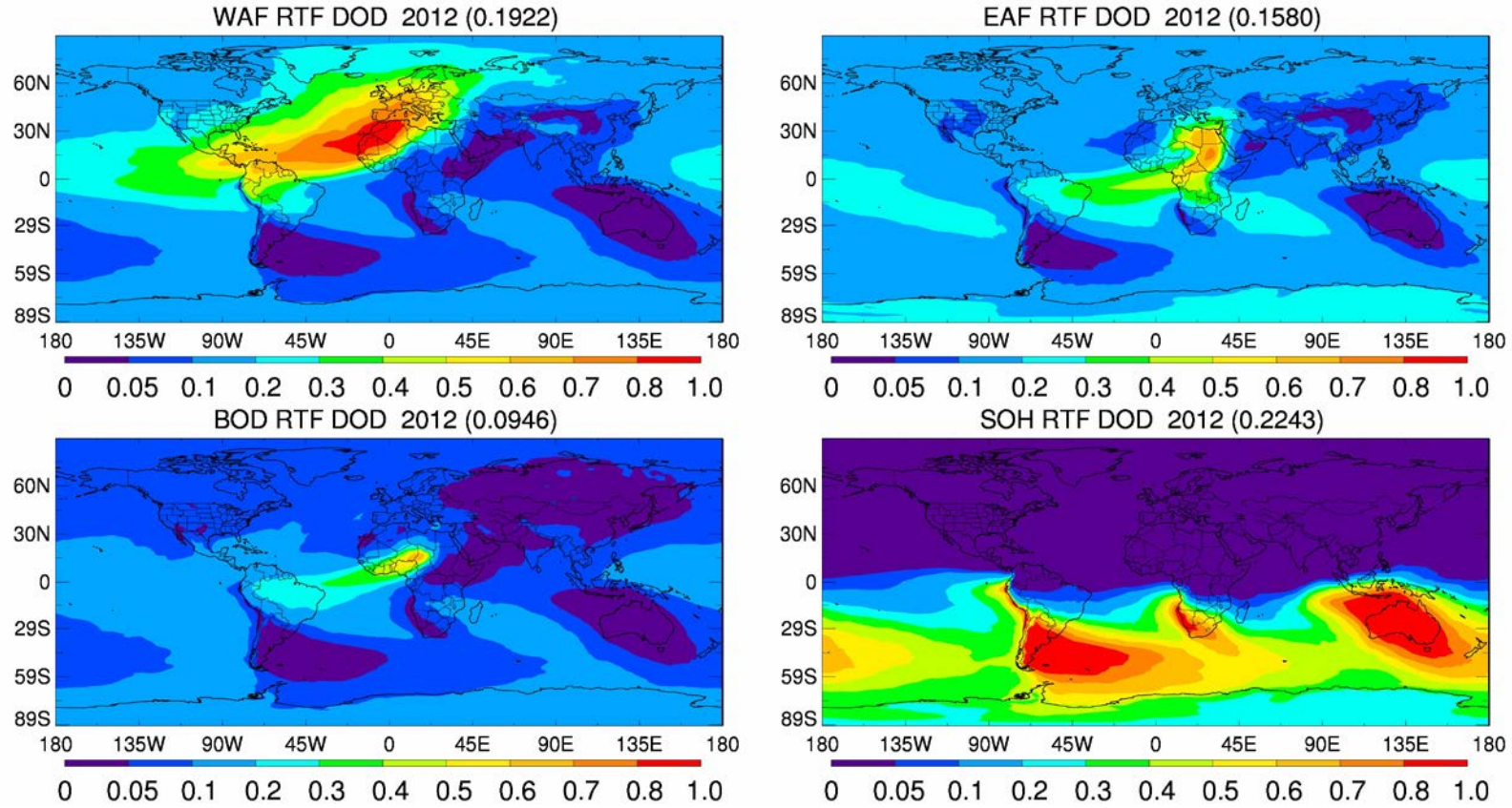






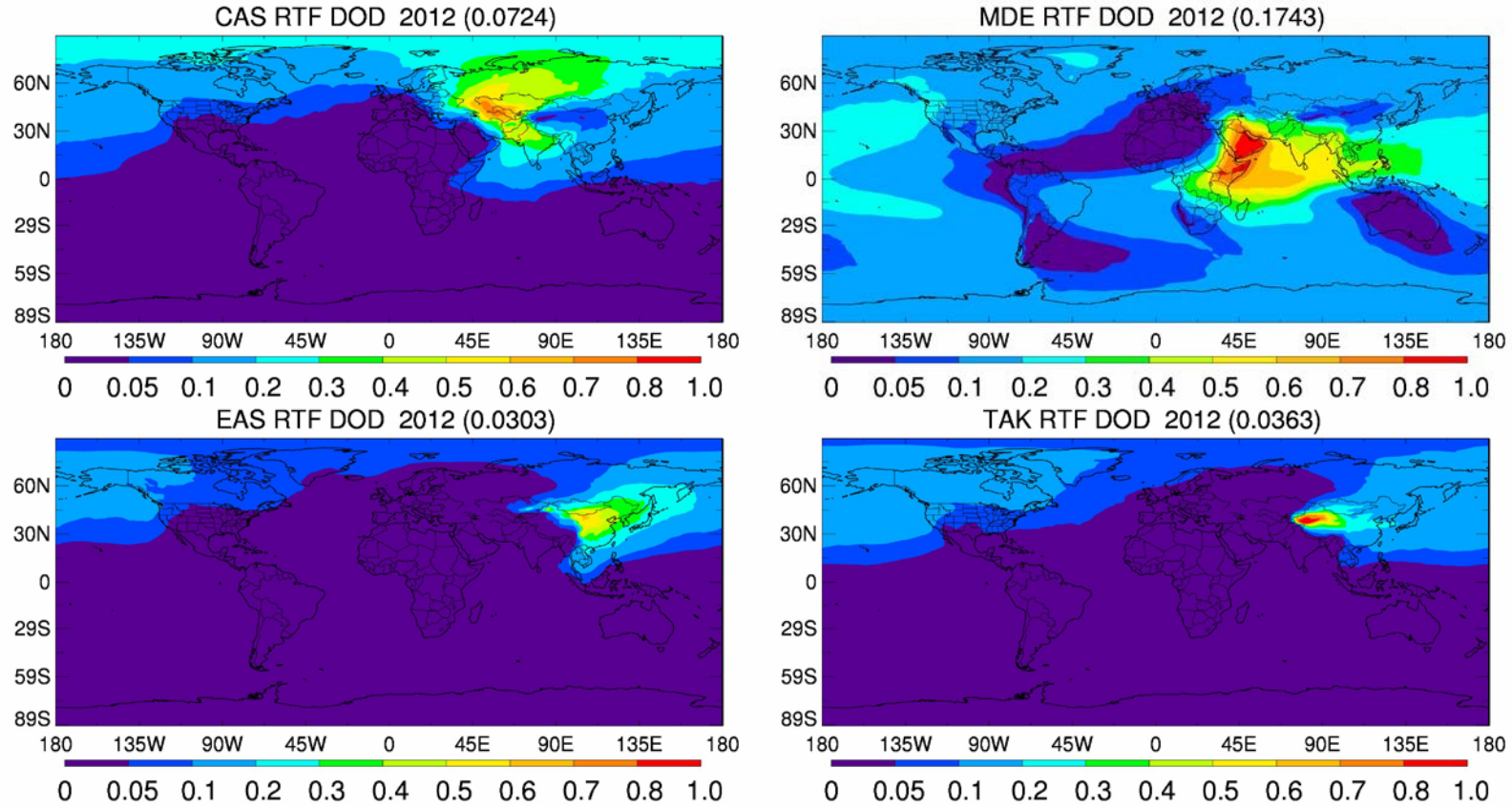
Attribution of Africa and SOH sources

RTF(DOD)=DOD(tag)/DOD(base)



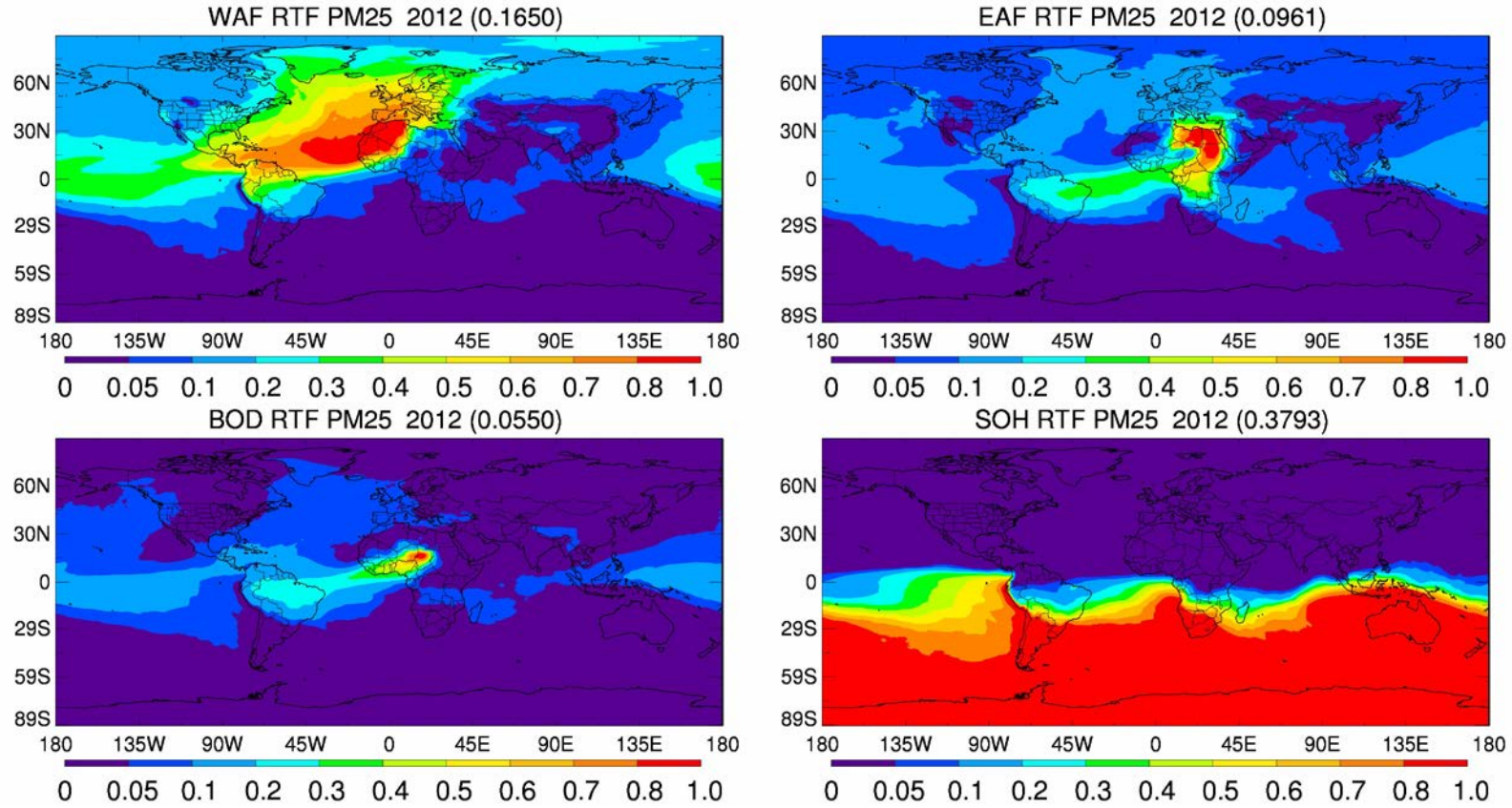
Attribution of East & West. Asia sources

RTF(DOD)=DOD(tag)/DOD(base)



Attribution of Africa and SOH sources

RTF(PM25)=PM25(tag)/PM25(base)



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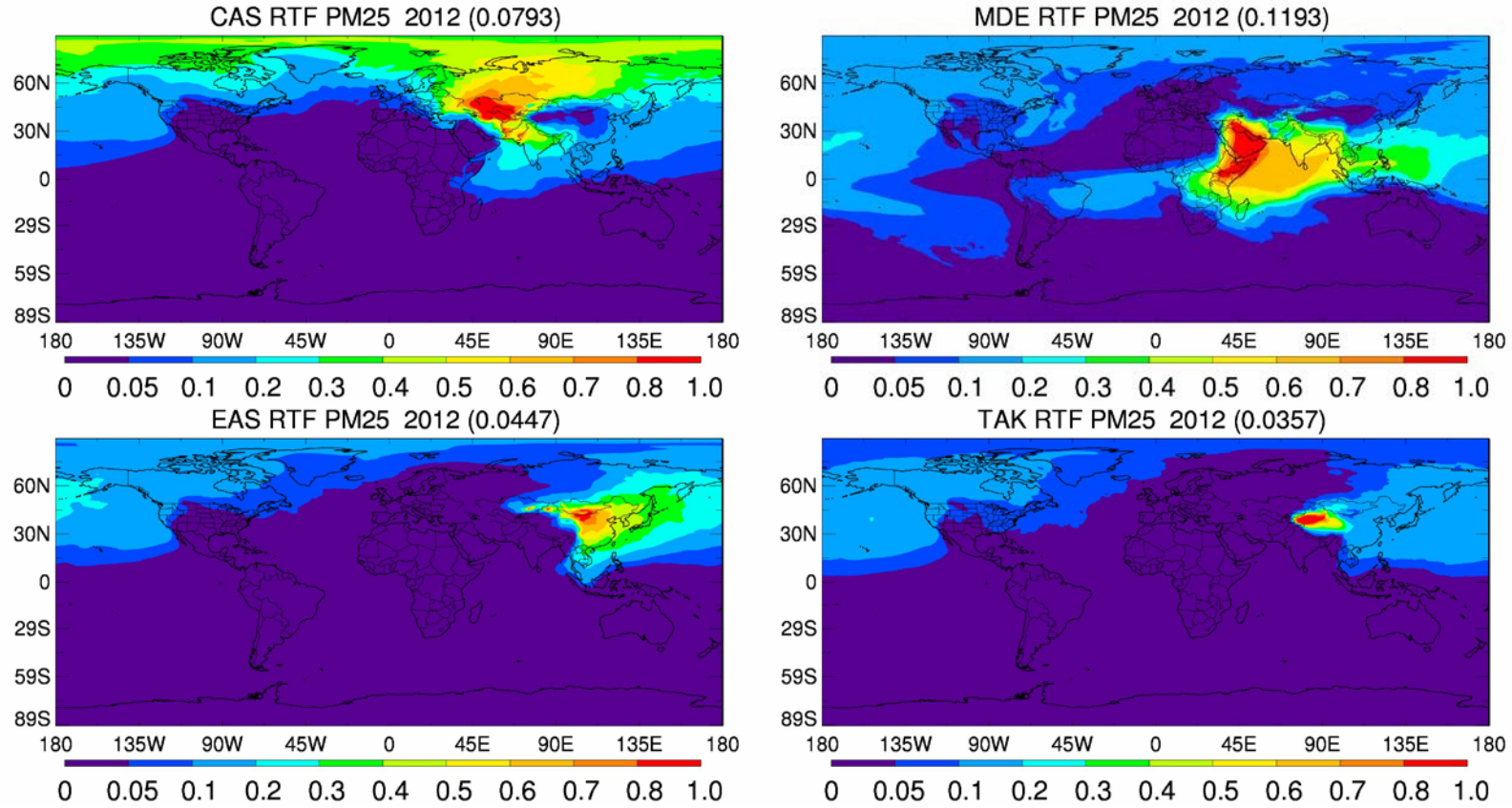
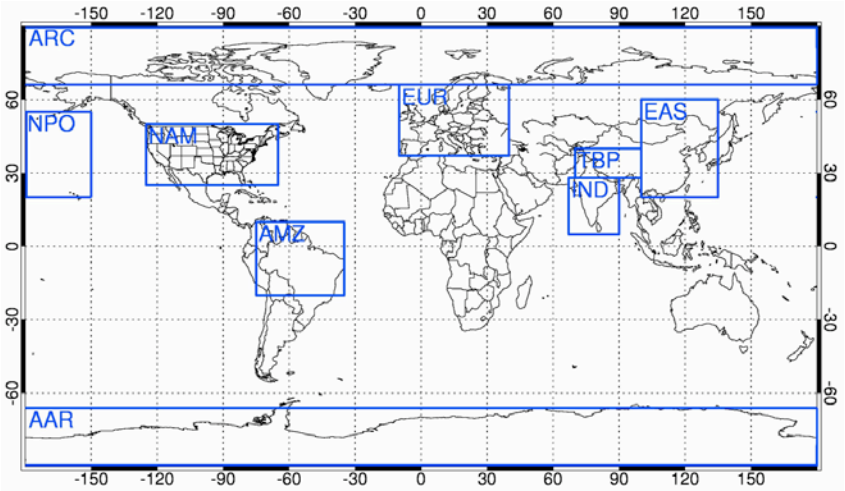
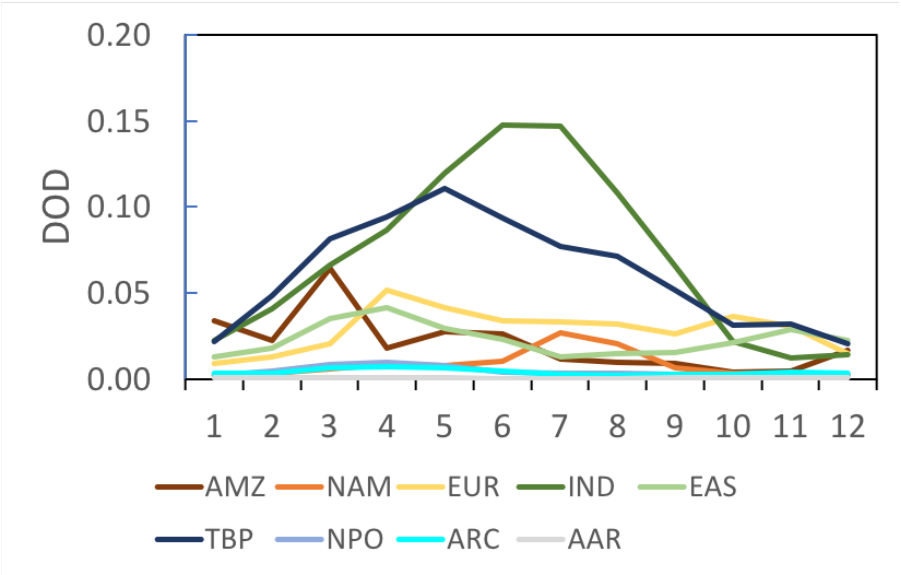
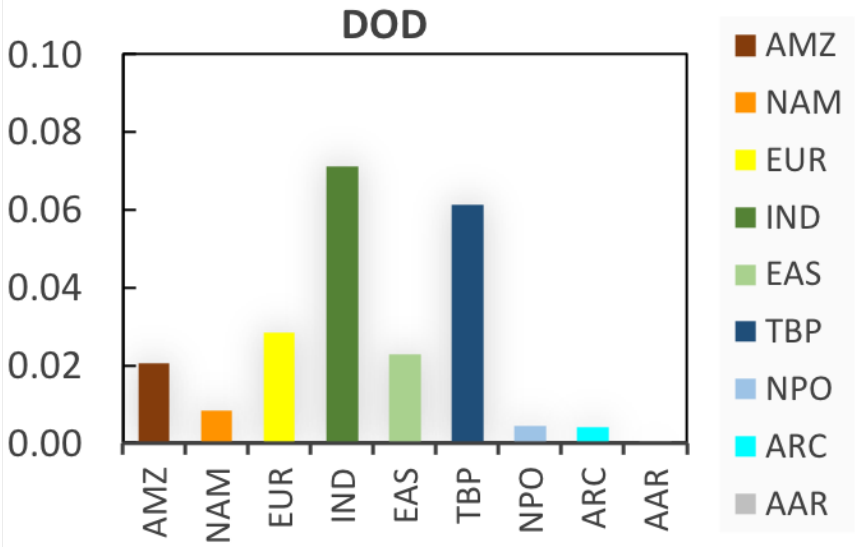


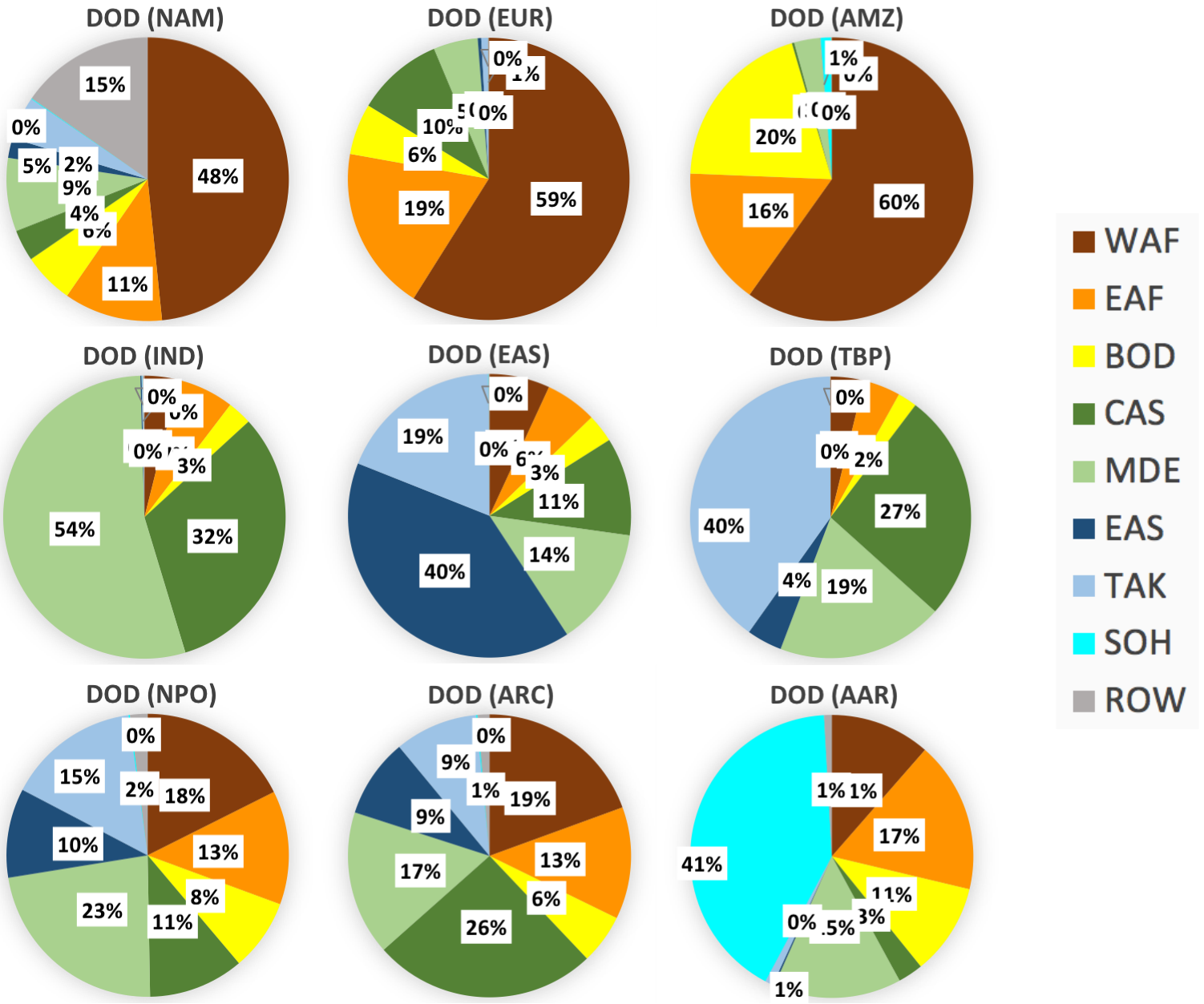
Receptor regions, monthly and annual DOD



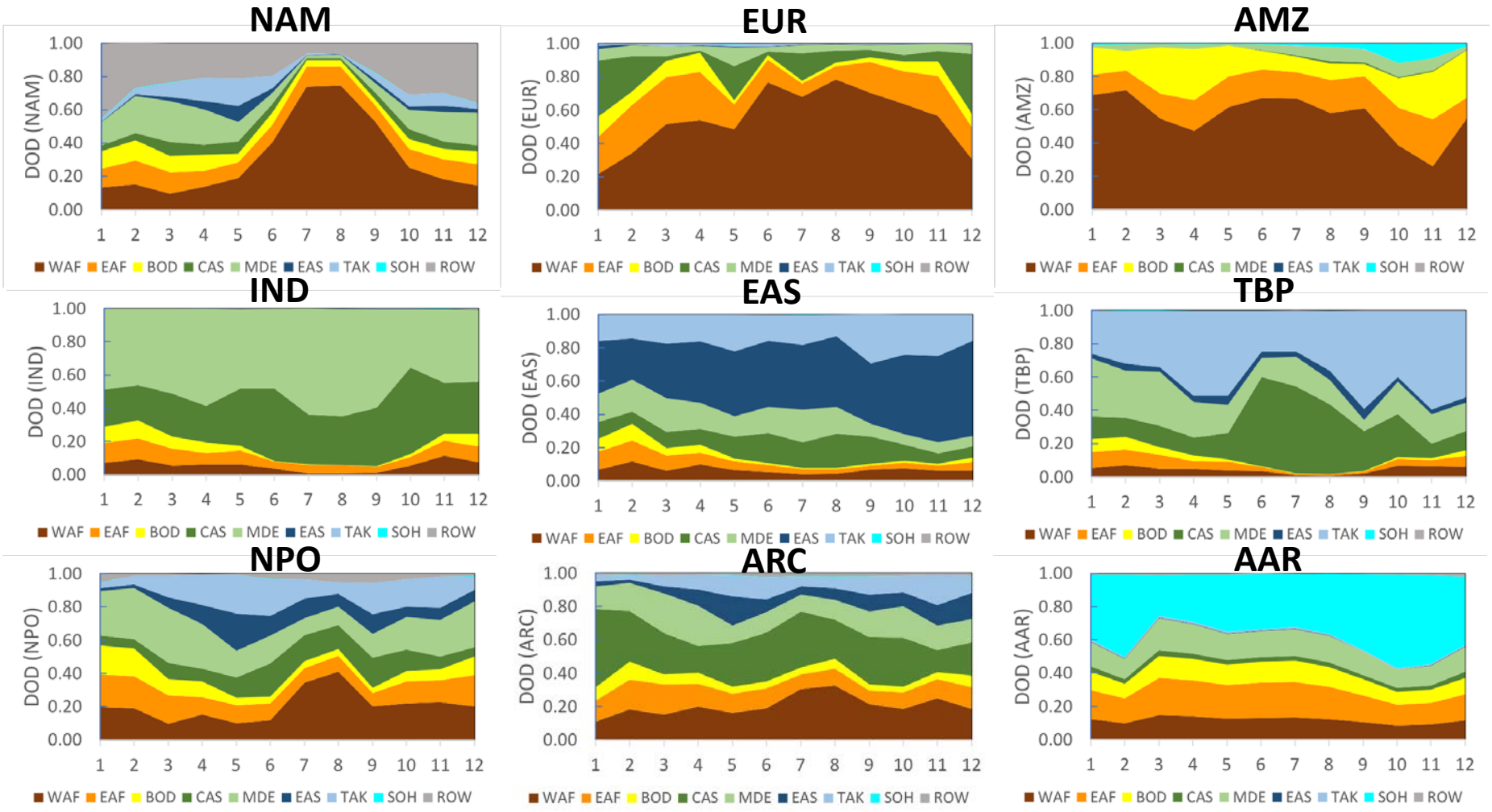




DOD source attribution to receptors (ANN)



DOD source attribution to receptors (Monthly)



Summary (GEOS only!)

- North Africa is most dominant source in global scale, however other sources are sometimes more important in regional scale.
- PM25 is mostly controlled by the nearby sources, however DOD is also significantly affected by the transported dust.
- North America, Europe, Amazon is dominated by African sources.
- The impact of Bodele is limited mostly to Atlantic ocean and Amazon.
- India is dominated by Middle East followed by Central Asia.
- Central Asia and West Africa are major dust sources for Arctic.
- East Asia and Taklimakan sources contribute about 25 % DOD over Pacific.
- Southern Hemispheric dust source is dominant PM25 over SH, however Northern Hemispheric dust source accounts for 60% of Antarctic DOD.

AeroCom experiment

- We propose an AeroCom experiment to improve our understanding of global and regional dust source attributions.
- We will provide tagged regions, model simulation period, and output specifics in near future.
- Please contact to me during the meeting or email to dongchul.kim@nasa.gov

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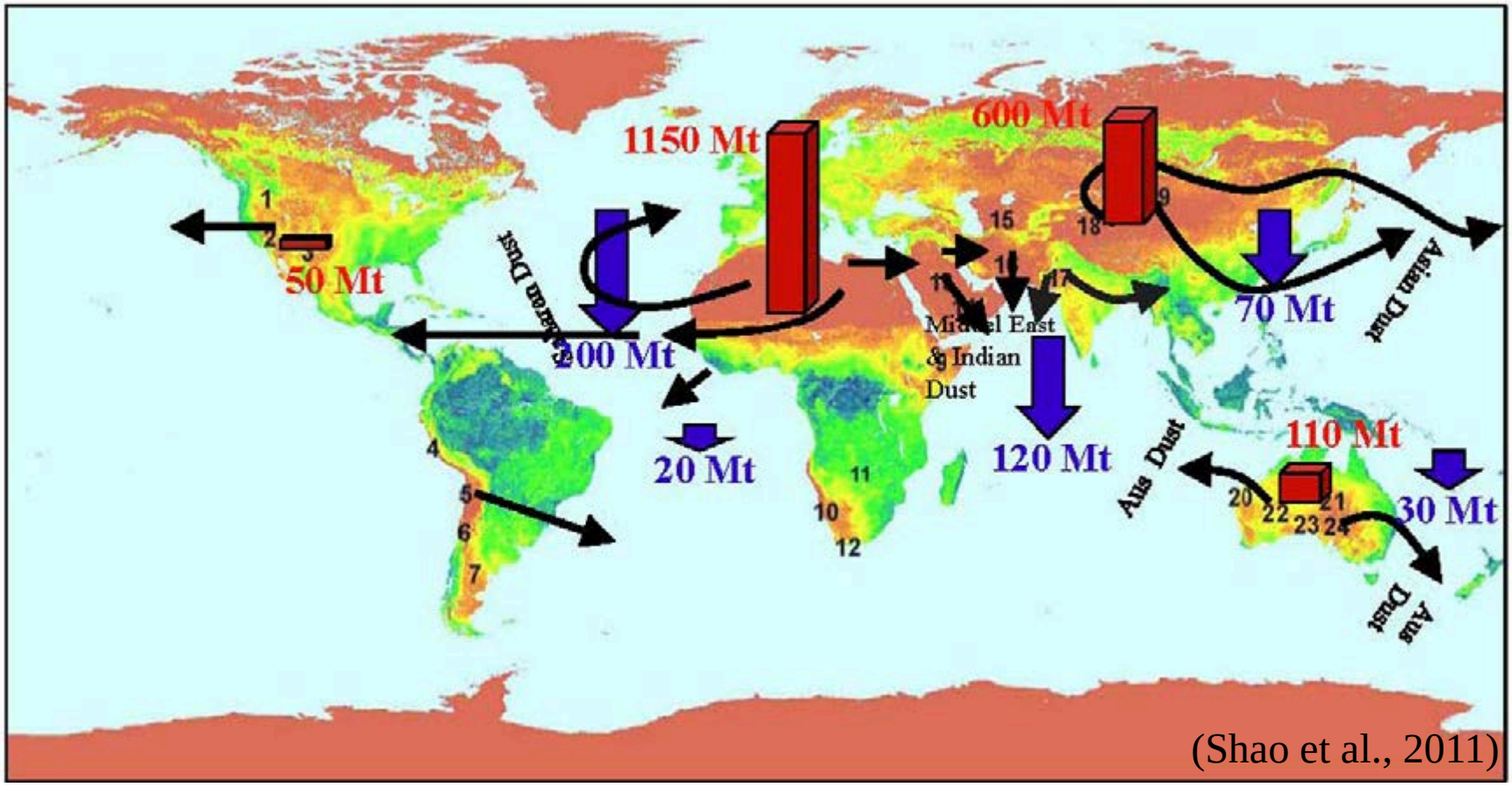

(Shao et al., 2011)