Source Regions of Sea Salt Aerosols from Dome C, Antarctica

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MOTIVATION

Sea salt aerosol concentrations in Antarctica varies over long time scales (Fig. 1, Wolff et al., 2010). The most noticeable change is observed between glacial and interglacial periods. The larger sea ice coverage during the Last Glacial Maximum (LGM, 19 ka) impacts the trajectories of air parcels and sea salt aerosol formation processes.

The aim of this project is to understand how changes in weather patterns influence sea salt aerosol concentrations in Antarctica. This aim is achieved by means of climate model simulations and air parcel trajectories.

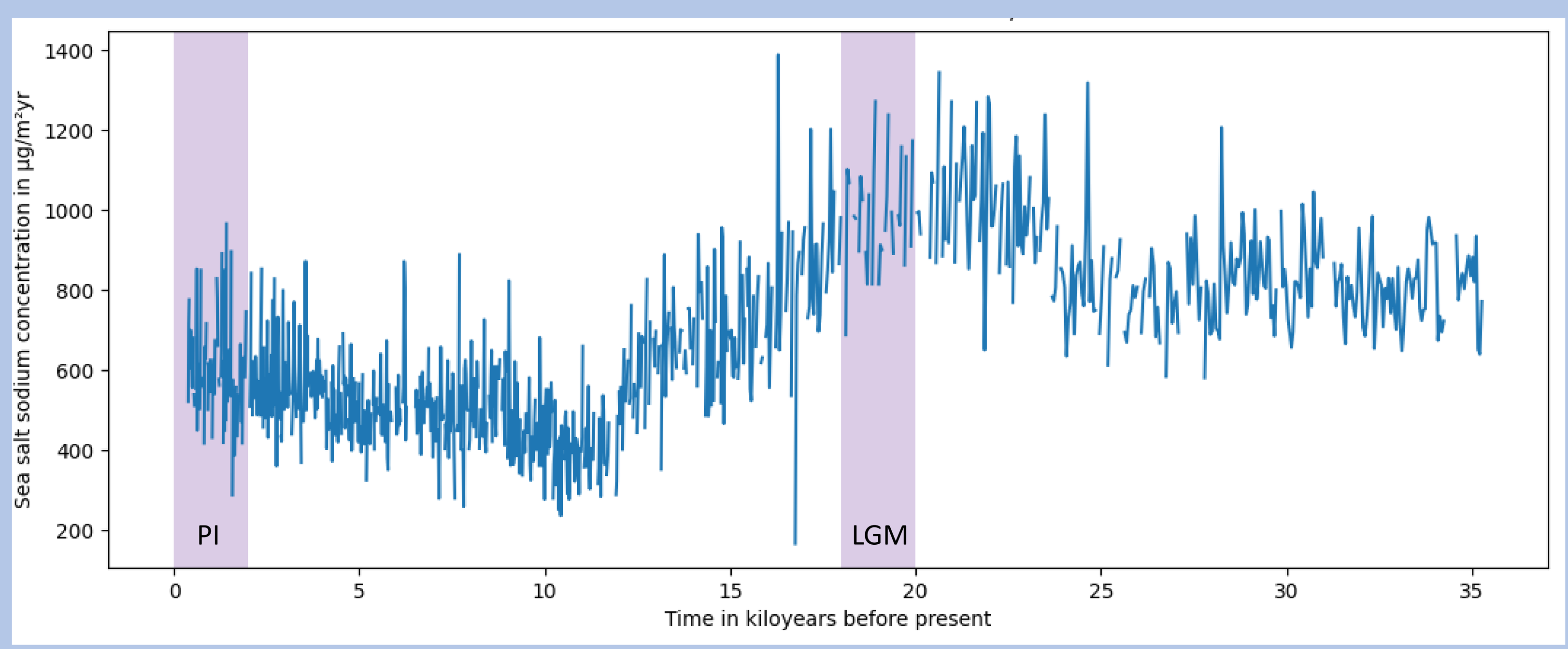

Figure 1: Sea salt sodium concentration in µg m^{-2} yr^{-1} at Dome C, Antarctica.

CONCLUSION

The largest share of the air parcels approach Dome C from the direction of Australia in the presented three winter seasons (Fig. 2). However, the impact of the source, transport and deposition processes of sea salt aerosols still need to be considered. These processes include high wind velocities needed for the formation of aerosols, and wet or dry deposition (Table 1).

	Source		Transport	Deposition	
	Open ocean	Sea ice		Wet	Dry
Processes	Trapped air bubbles burst at surface	Fine ice structures saturated with sea water get blown away	Transportation by wind	Washing out by precipitation	Gravitational settling of small particles
Requirements	Wind speed > 4 ms^{-1}	Wind speed > 4 ms^{-1}		Precipitation	Slow wind speed

Table 1: Source, transport and deposition processes of sea salt aerosols in Antarctica.

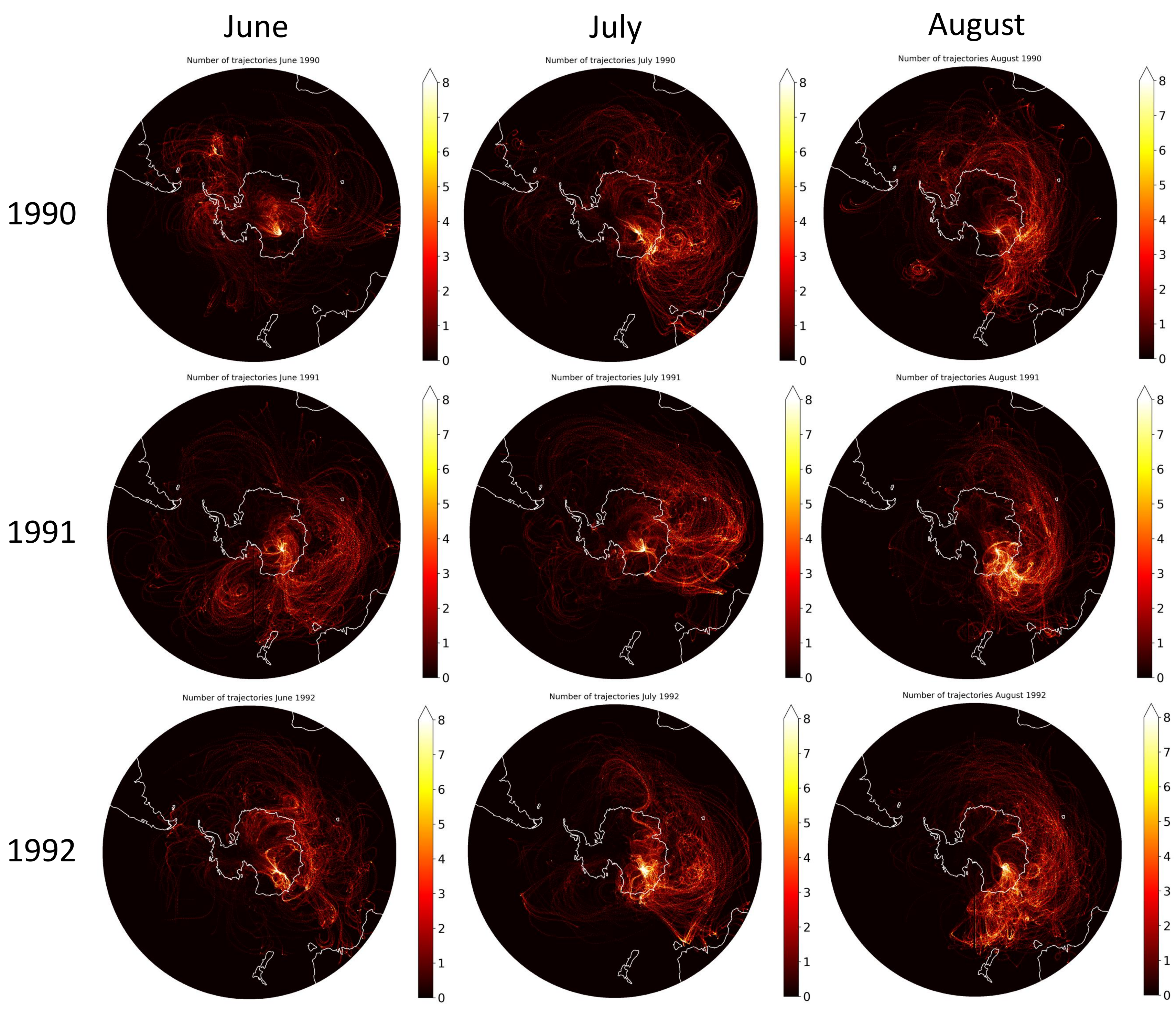

Figure 2: Number of trajectories at each grid point for the winter months June, July and August of the years 1990, 1991 and 1992.

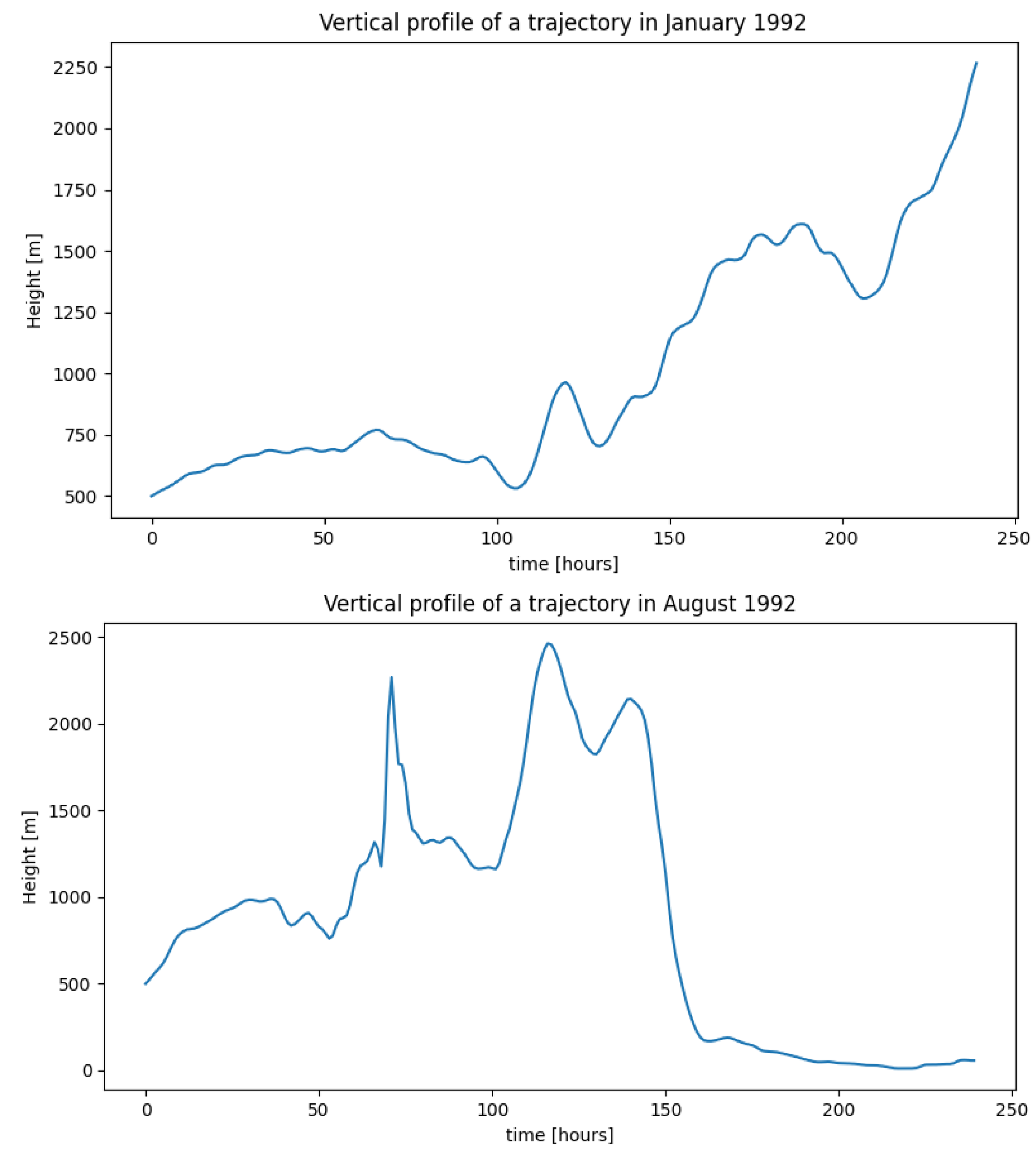

Figure 3: Vertical profiles of single trajectories. The January trajectory is too high to take up sea salt aerosols, while the August pathway is close enough to the sea surface to take up sea salt aerosols.

METHODS

10-day backward trajectories are calculated with the trajectory model FLEXTRA (Stohl, 2000) using the wind fields of ERA5 reanalysis (Hersbach et al., 2020) with an hourly resolution. The air parcels are started at Dome C, Antarctica (75°06'S/123°21'E) in an elevation of 500 metres. As next steps trajectories will be calculated for the LGM with data from the global climate model CESM1.2, and for the preindustrial (PI) period to identify changes between the two periods and to compare the climate model to ERA5 reanalysis (Table 2).

NEXT STEPS:

- Filter trajectories
- Calculate trajectories for LGM
- Calculate trajectories for PI, compare accuracy to ERA5

Dataset	Period	Year	Temporal Resolution
ERA5	present day	1990 CE	hourly data
CESM1.2	PI	1850 CE	6-hourly data
CESM1.2	LGM	19050 BCE	6-hourly data

Table 2: Datasets used during the Master thesis project.

REFERENCES:

Stohl, A., The Flextra Trajectory Model Version 3.0 user guide, pp 1-19, 2000.

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Wolff, E.W. et al., Changes in environment over the last 800,000 years from chemical analysis of the EPICA Dome C ice core. Quaternary Science Reviews, 29, 285-295, 2010.

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