

NanoShip: Are there any new particle formation events over the North Sea?

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Over the continents, we are familiar with frequent formation of new nanometer-sized particles in the atmosphere, called “new particle formation” (NPF) (Kulmala et al., 2004). After subsequent condensation growth, the nanoparticles become large enough to be optically active and to impact on cloud formation, and thereby climate. In the marine boundary layer of pristine oceans, NPF events are not frequent (Pirjola et al., 2000). In the NanoShip project we investigate for the first time whether NPF events take place in a polluted marine boundary layer, like the North Sea considering ship traffic being the source for relevant precursors involved in the NPF.

During the NanoShip project, particle number size distribution measurements were carried out at a marine site (Høvsøre) at the Danish peninsula Jutland during 2012 to investigate the link between formation events and winds from the North Sea. Also archived data from the Norwegian and Dutch EUSAAR sites Birkenes and Cabauw were used to infer the appearance and frequency of formation events during conditions with winds from south-east and north-west, respectively.

We can infer where the formation of 1.5 nm diameter particles takes place by using the particle number size distribution data from Høvsøre and meteorological back trajectories according to the NanoMap method described by Johansson et al. (2012).

The NanoMap method can basically be described as follows (example): We hypothetically see that formation of 1.5 nm diameter particles is taking place between 10:00 and 12:00 am at Høvsøre, and that these particles grow to 30 nm in diameter after 7 to 9 hours. Hence, the 30 nm particles that we observe at Høvsøre in the evening have been formed 7 to 9 hours ago upwind of the site. With the back trajectories we trace the air back to when the particles were formed as 1.5 nm diameter particles somewhere over the North Sea.

In total, 82 days were classified according to the Dal Maso et al. (2005) classification, and during 41 % of these days there was a NPF event, and 17% of the days were a type 1 event. Only type 1 events were used in the NanoMap analysis. Figure 1 shows the location of particles with predicted diameters of 1.5 nm (preliminary

results) from the NanoMap analysis for the 14 days with type 1 NPF events at Høvsøre.

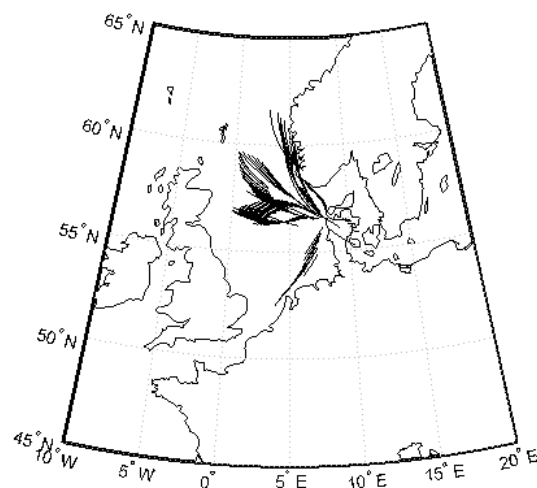


Figure 1. The location of new particle formation of 1.5 nm diameter particles (black lines) according to the NanoMap method and particle number size distribution data recorded at Høvsøre (56°27' E, 8°09' N, 2 m a.s.l.).

We can conclude that NPF events are taking place frequently over the North Sea. The favourable conditions are preferably when we have cyclonic, low pressure air masses reaching the Danish marine site.

At the EAC conference, we intend to present in addition, an analysis of EMEP emission maps, aerosol condensation sinks, and if certain meteorological conditions or aerosol sources, like shipping are favouring the NPF over the North Sea.

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Kulmala, M., et al. (2004) *Aer. Sci.*, **35**, 143-176.

Pirjola, L., et al. (2009) *J. Geoph. Res.*, **105**, 26531-26546.