

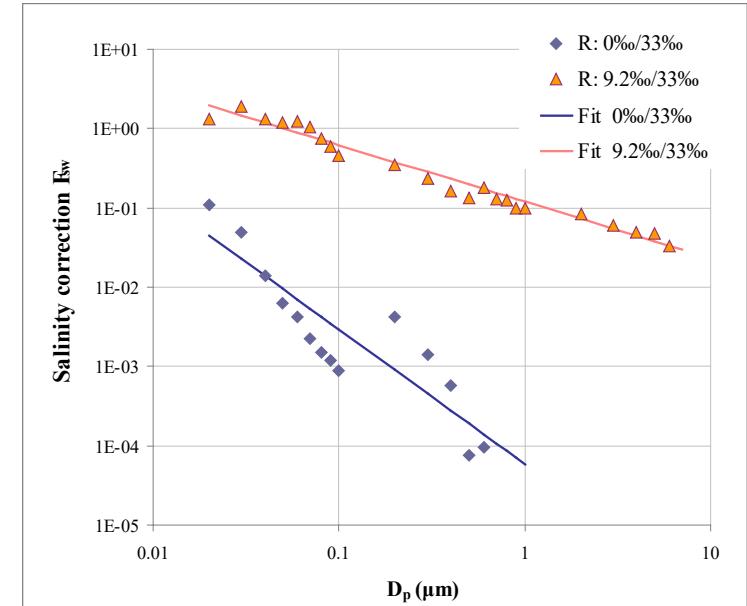
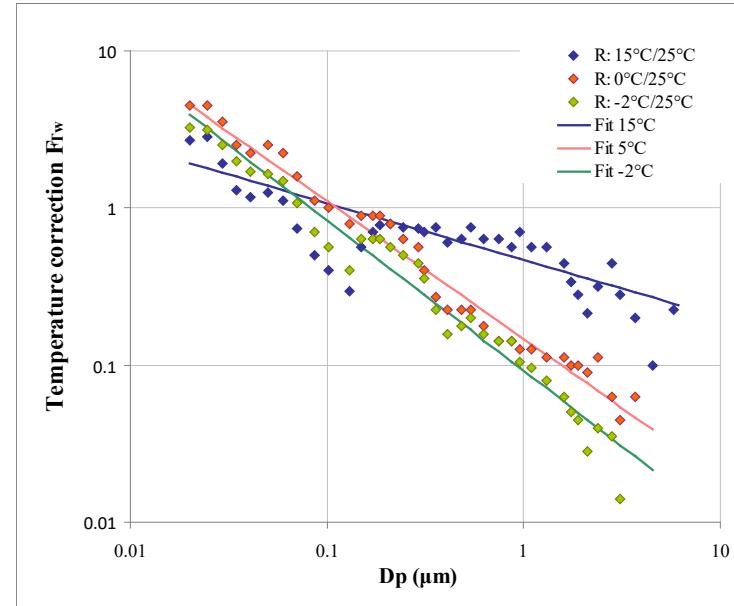
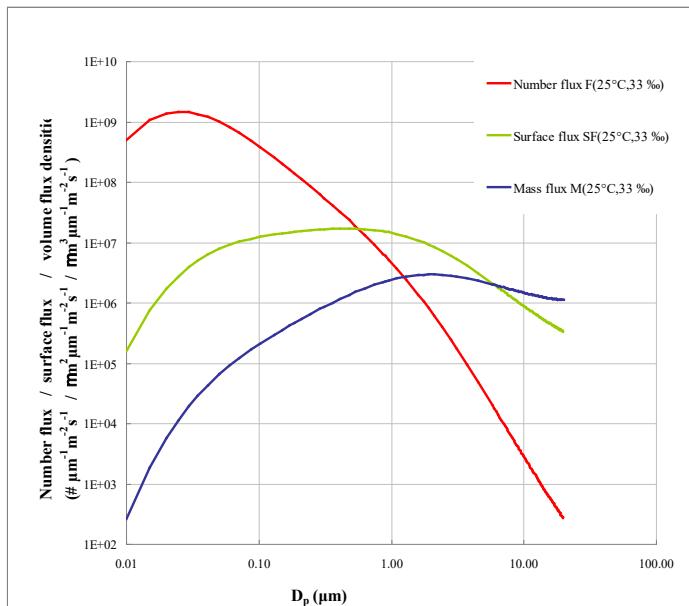
Sea salt source in SILAM: present vs future formulations

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SILAM team



SILAM sea salt source now

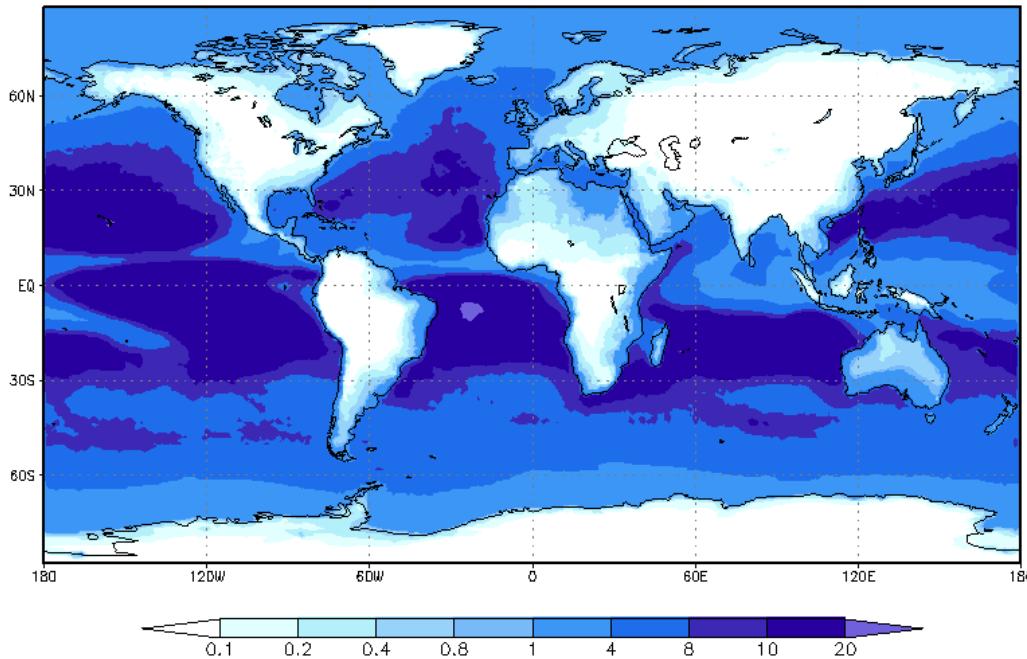
- Sofiev et al (2012):
 - shape function: Monahan et al (1986) + Martensson et al (2003)
 - wind dependence: $u_{10}^{3.41}$ after Monahan & O'Muircheartaigh (1980)
 - temperature dependence: reparameterised Martensson et al (2003)
 - salinity dependence: reparameterised Martensson et al (2003)



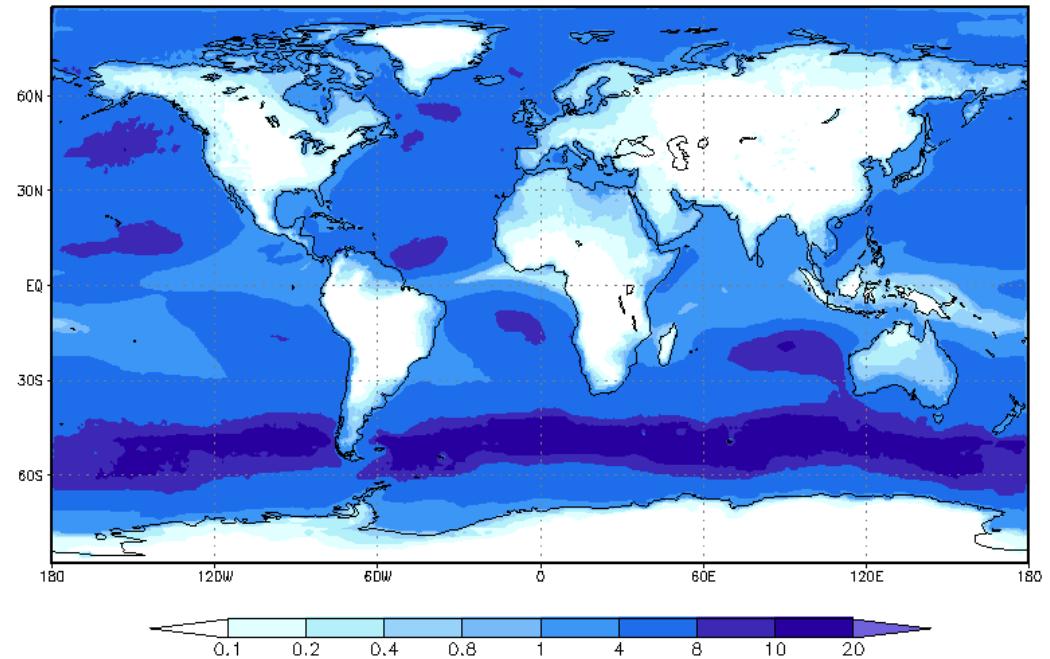
Known problems

- Addition of the sea salt aerosols helps with bias but does not improve correlation
- Dependencies seem to be too sharp

Actual water temperature

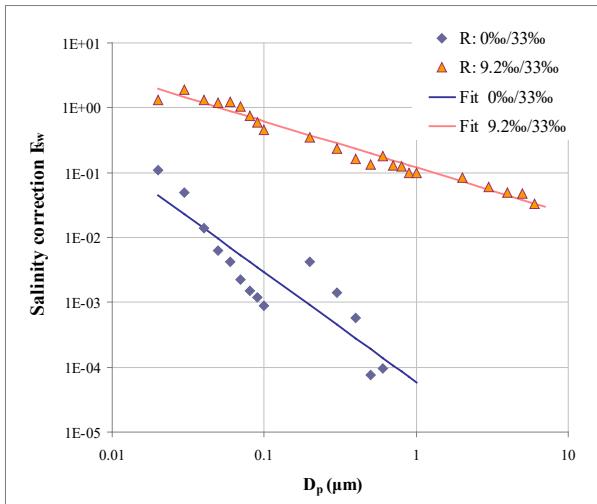


Constant water temperature

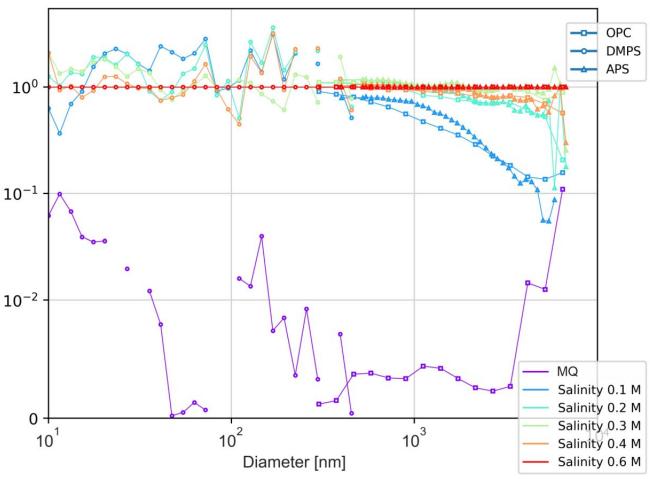


Issues (1)

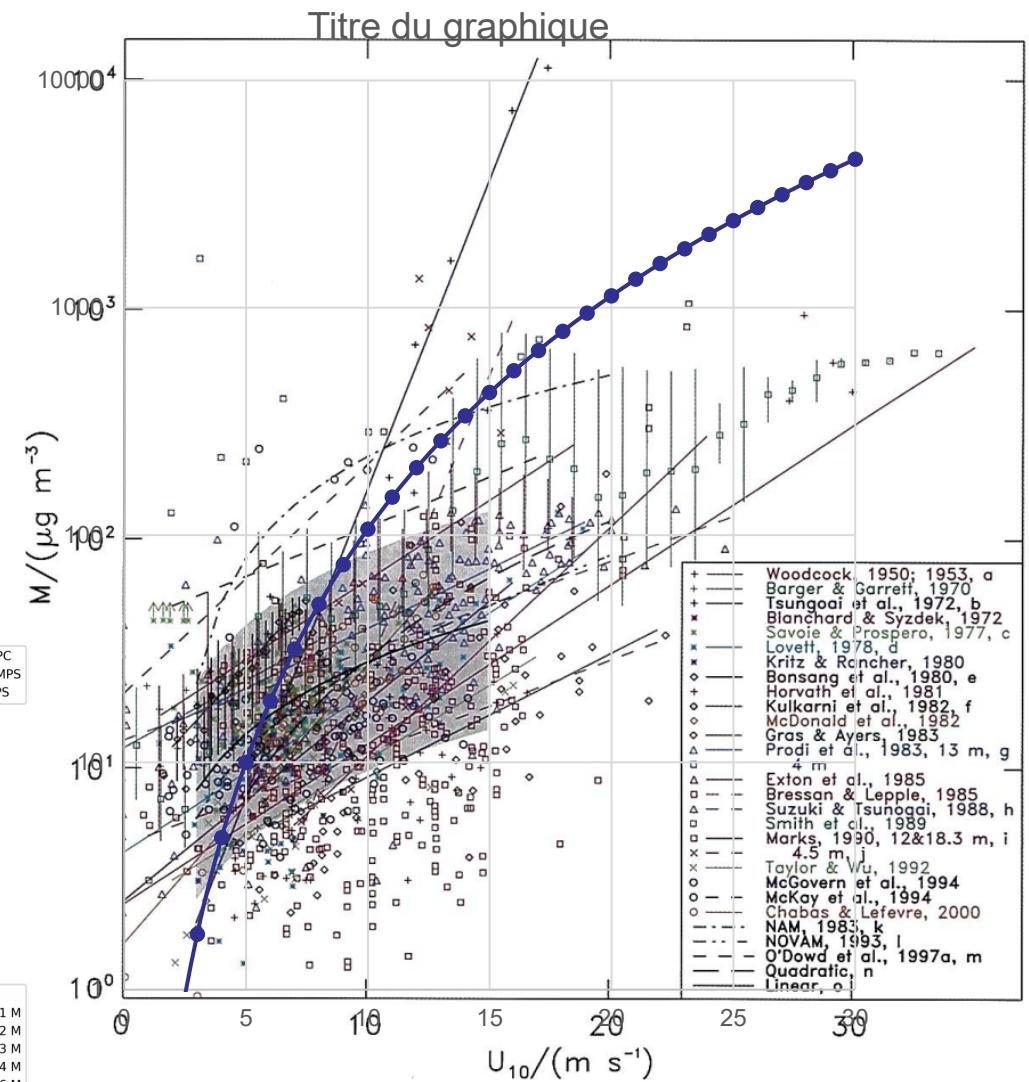
- Dependence on wind speed
 - 3.4 power is too sharp
- Dependence on salinity
 - also too sharp



Reparameterised Martensson et al, 2003



New experiment Sofieva et al, 2022



Lewis Schwartz, 2004

Issues (2)

- Dependence on temperature
 - totally different behavior: saturation

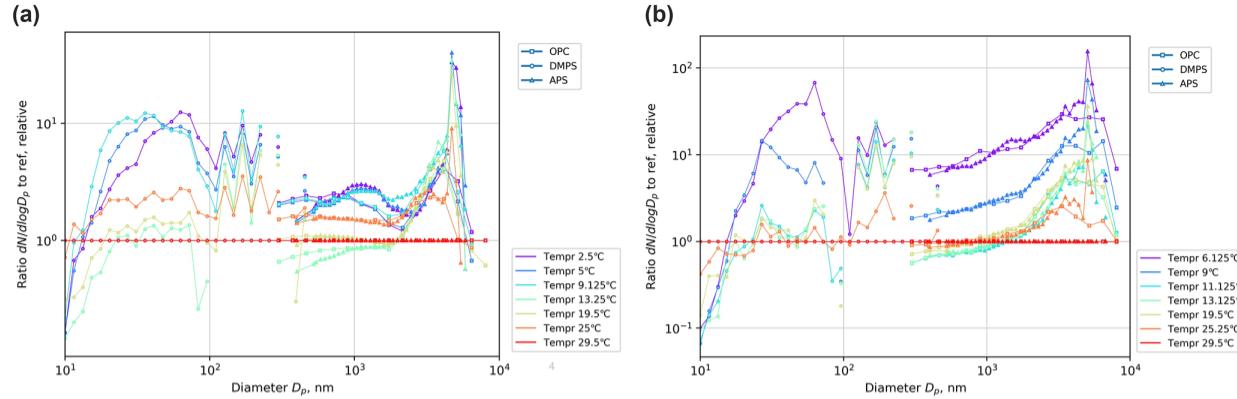


Figure 8. Water temperature effect on particle size spectrum for salinity $S = 0.1$ M (a) and $S = 0.6$ M (b). In both panels, the spectra for different temperatures are normalized with the spectrum at $T = 29.5^\circ\text{C}$ and the corresponding salinity. Color legends present mean temperatures of the experiments.

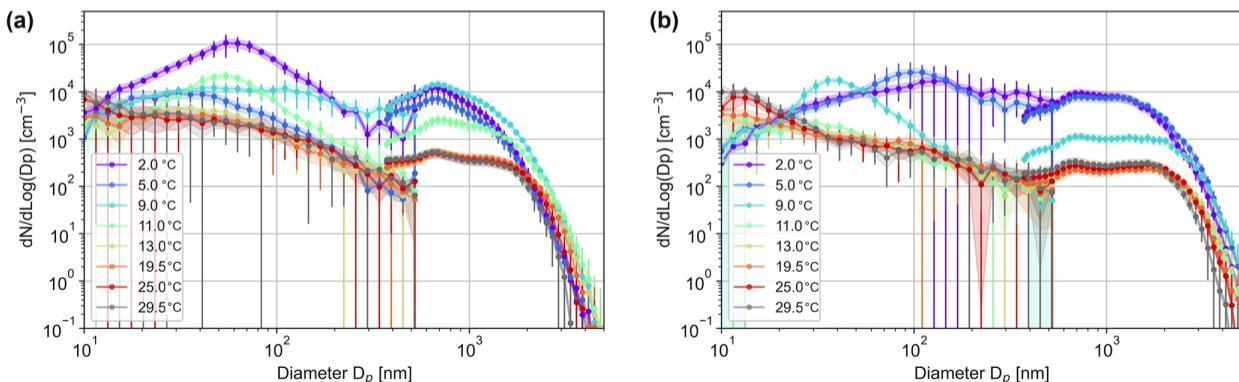
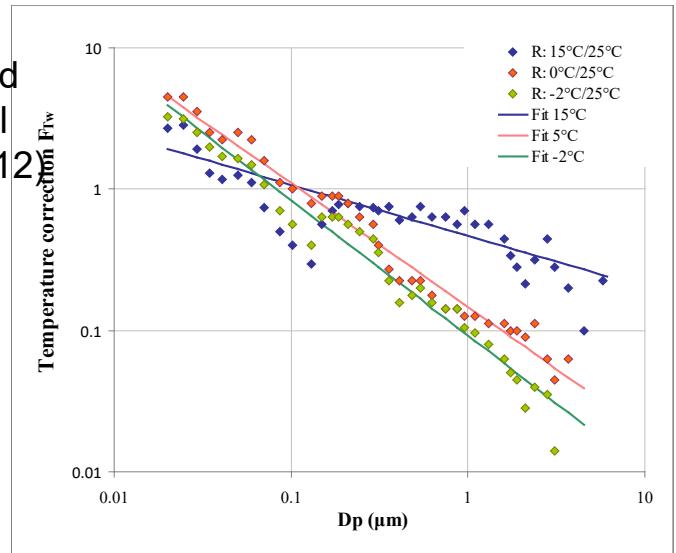
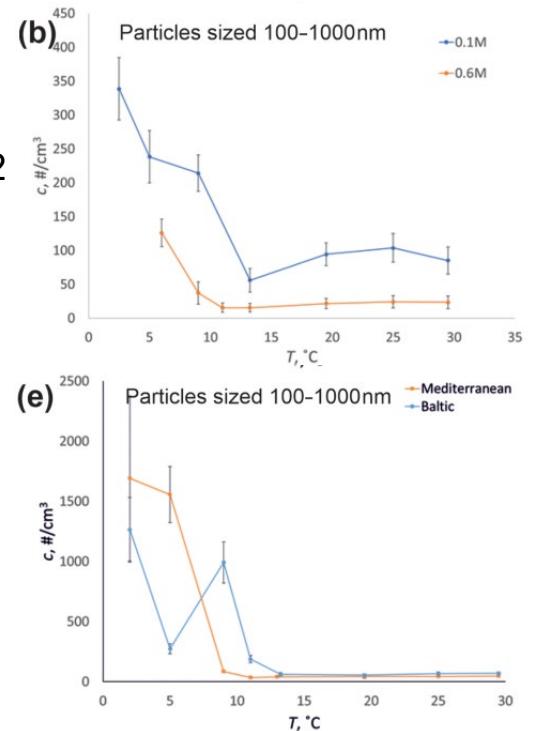


Figure 9. Temperature-dependent aerosol size distributions for Baltic (a) and Mediterranean (b) seawater bubbled at 0.8 L min^{-1} , measured with DMPS (circles) and APS (circles).

Reparameterised
Martensson et al
(Sofiev et al, 2012)



New experiment
Sofieva et al, 2022



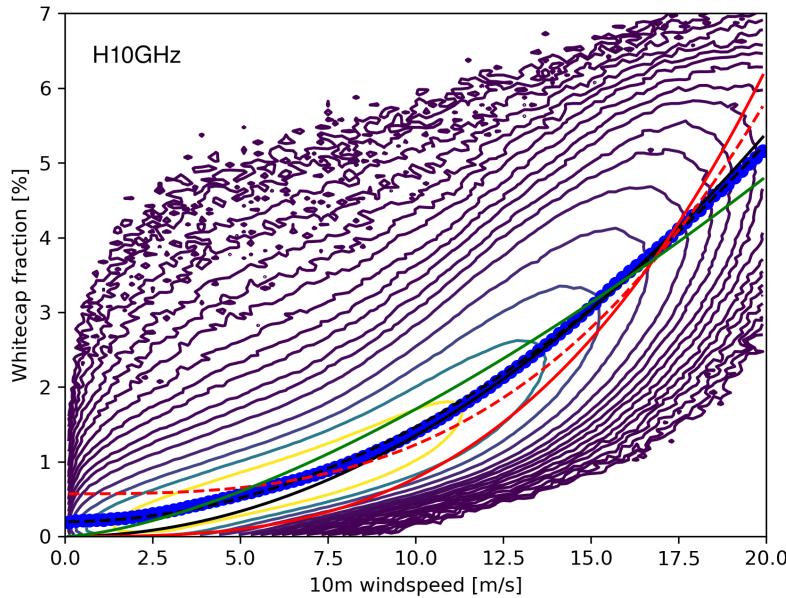
New sea salt source

- New wind speed dependence: white cap fraction from spaceborne wind scatterometer
- New salinity dependence (analytical formula with refitted coefficients)
- New temperature dependence (new fit)
- Model identification via data assimilation

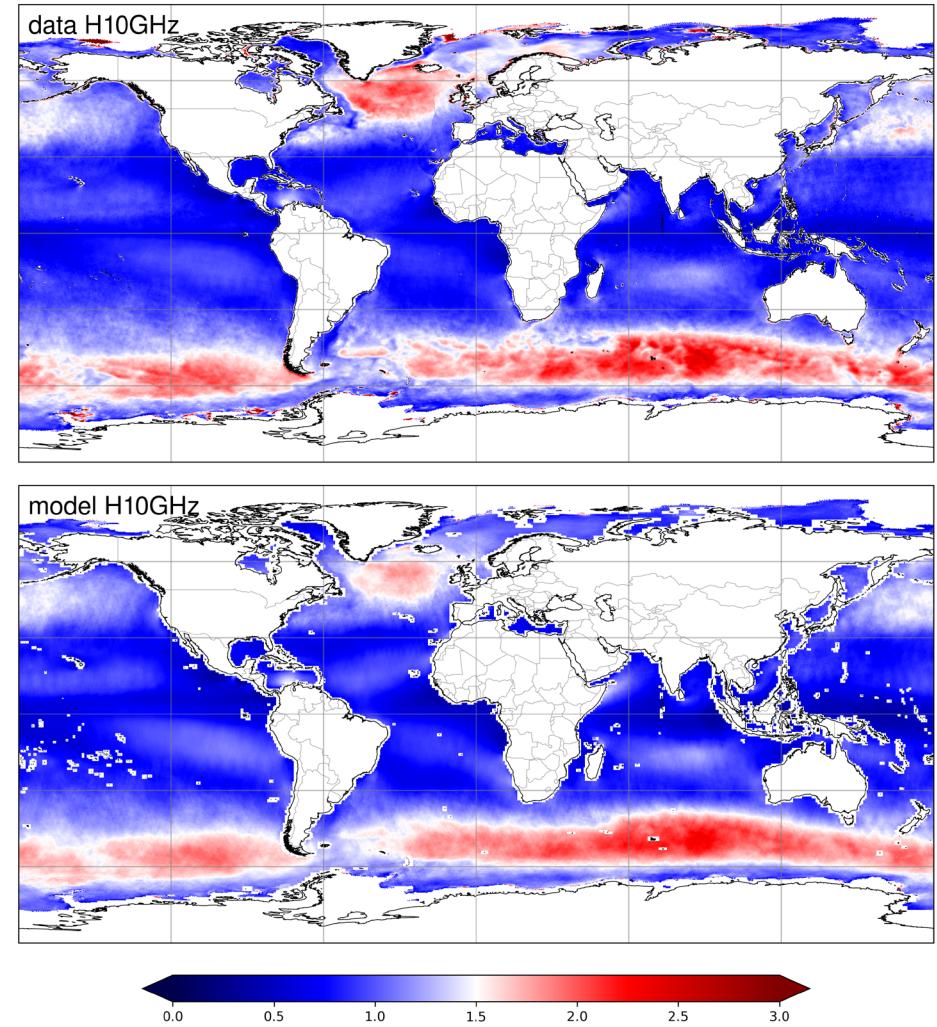
New sea-salt source: whitecap fraction

Satellite data (2014):

- Extremely noisy
- Depends on polarization and frequency
- Does not support pure cubic dependence (**red-solid line**)



Histogram of WCF data, blue dots indicating median values in each velocity bin, together with several fits to these median values.



2014 mean whitecap fraction from satellite data (top) and from the model (bottom).

Results:

- Better fit with squared dependence, including non-zero off-set (**black dashed line**):
- **$WCF(H10GHz) = 0.0127 U_{10m}^2 + 0.198, [\%]$**
- Some underestimation at high velocities.
- Dependence on sea-temperature could not be identified.

Summary

- The decades-long-nearly-consensus source term for sea salt emission seems to be wrong in every part
- Also experience of SILAM: efficient bias reduction but poor correlation
- Recent lab experiments are not without controversy, especially the bubble-generator and plunger-based methods show different results
- The key messages are however clear
 - near-quadratic dependence on windspeed
 - cubic-root dependence on salinity
 - modest dependence on temperature, possibly with saturation effect