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Dust and pyrogenic iron boost phytoplankton blooms in sub-Antarctic waters of the Tasman Sea

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Although it is commonly accepted that atmospheric deposition of Fe particles can fertilise phytoplankton, there is yet no clear evidence on how such a fertilisation effect takes place. Several studies have attempted to link individual dust events with surface chlorophyll responses but generally, they do not find a clear correspondence between dust deposition and its impact on chlorophyll. In this work, we use a biogeochemical model to show that the atmospheric deposition of Fe in high-latitude seas, rather than creating instantaneous phytoplankton responses, replenish the upper mixed layer of the ocean during the pre-bloom period, from winter to early summer. The Fe accumulated at the surface boosts the phytoplankton bloom of the following summer, resulting in surface chlorophyll accumulations of up to 3 times larger than the years without atmospheric deposition. We used this mechanism to explain the strong inter-annual variability of the phytoplankton bloom in sub-Antarctic iron-limited waters east of Australia. Putting together more than a 15-years-long record of ocean colour observations and atmospheric aerosols reanalysis we uncovered a strong correlation (r^2>0.6) between the dust that crossed the region during the pre-bloom period and the magnitude of the surface chlorophyll bloom. Interestingly, the correlation increased when taking into account pyrogenic aerosols in addition to dust. Our study presents the first observational link between Climate Change-enhanced droughts and wildfires, atmospheric aerosols and primary production of iron-limited waters.