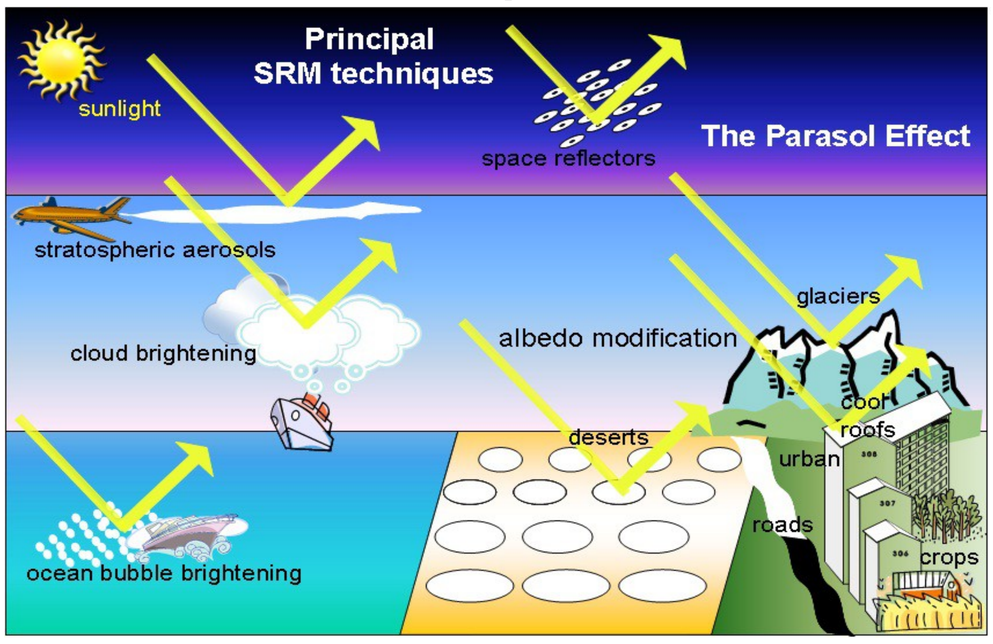
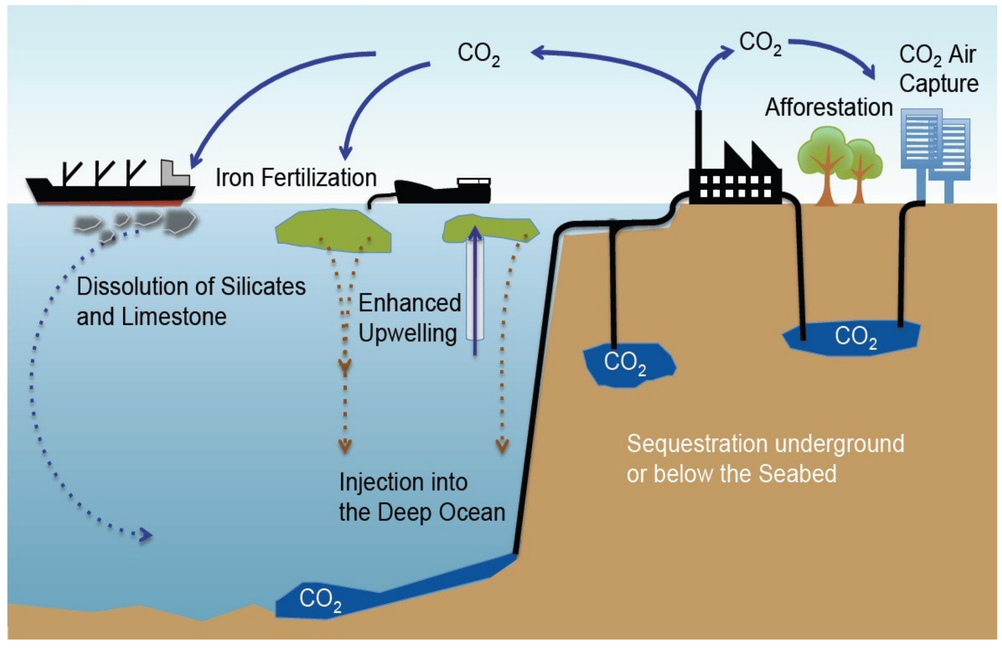
Principal SRM and CDR geoengineering methods





OUR PROPOSAL: enhancing an already operative super CDR+SRM mechanism which is in use by Gaïa after volcanic eruptions and during dusty glacial ages: the Iron Salts Aerosol Method

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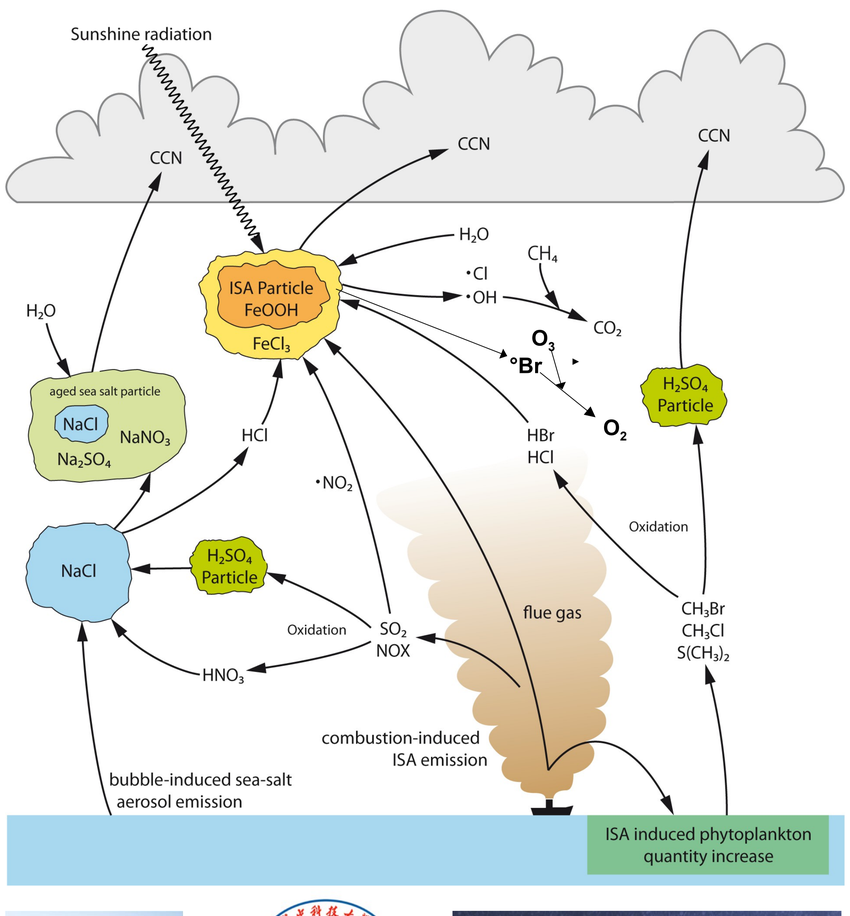
It consists in adding iron (for instance ferrocene) off-shore in marine bunker C fuels to be ejected by the smoke stack of container ships, or burning separately fuel iron mixtures with halogen (like HCl) mixed on buoyant flue gases, into the oceanic or the continental troposphere, far from populated areas…

The aerosols formed will have a cooling effect like the Marine Cloud Brightening method proposed by Latham & Salter [2, 3]. Neighboring the photolyzed Fe(III), in such aerosol particle Cl^- is transformed in the troposphere to gaseous atomic Cl, which will destroy methane (the 2nd GHG in importance) by HCl generation. The Cl atom is regenerated from HCl by Fe(III) photolysis.

Some marine Br^- and I^- will also destroy tropospheric ozone (the 3rd GHG in importance) Sherwen [4] after activation by Fe(III) photolysis (the same way as Cl^-).

The iron aerosols stay between days and weeks within the marine boundary layer where they are dispersed and diluted before falling into the ocean or onto the vegetation, where they will have a CDR cooling effect like the Ocean Iron Fertilization (OIF) method proposed by Martin (1990) [5] which consists in moderate but far spread phytoplankton blooms which capture atmospheric CO_2. But it will have much less drawbacks as iron quantities are much smaller than for OIF, much more diluted and readily bio-available.



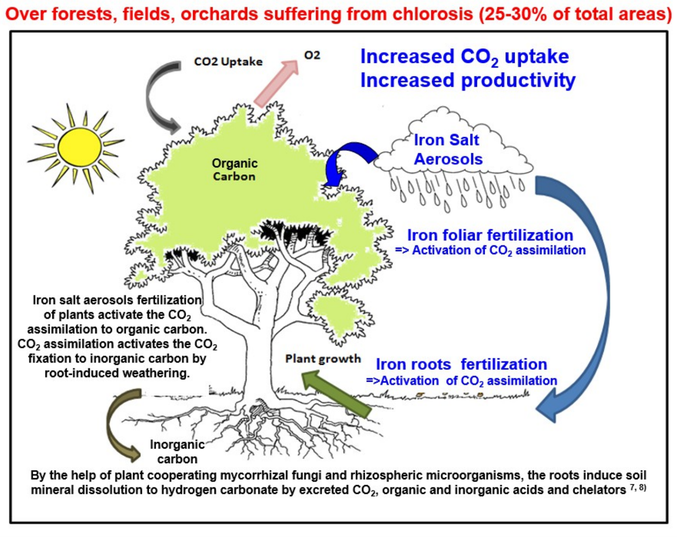
Principal Cooling Mechanisms of the Iron Salts Aerosol Method [1)]

- Planetary albedo increase by direct (ISA aerosols) and indirect (DMS generation) cloud whitening and cloud life-time elongation
- Atmospheric CH_4 depletion by photolytic chlorine activation
- Activation of the oceanic CO_2 absorption by surface cooling and pH increase
- At ocean surfaces: CO_2 absorption by generation of phytoplankton blooms
- On continents: CO_2 absorption activation by increase of crops, orchards and plants primary assimilation and by chlorosis prevention and thus growth activation of plants and CO_2 absorption activation by plant-induced weathering activation
- Tropospheric ozone and soot aerosols depletion
- Reduction of CH_4 emissions by terrestrial landscapes, from wet lands, peat bogs and tidal flats, both by inhibition of CH_4 production and oxidation activation
- Preventing ocean stratification…

The decision to minimize the sulfur content in marine fuel from 4% to 0.5 or 0.1% will have additional warming effects on the global climate: the clouds generated by ship flue gas has shown in the picture below will be drastically reduced in the future. The ISA-method is able to compensate this warming, as it generates again this type of high albedo cloud produced by the sulfur emissions of marine fuel.

Last but not least, the phytoplankton bloom will release dimethyl sulfide (DMS) and halogen organic gases, which again form aerosols in the troposphere with a SRM cooling effect and by destroying methane and tropospheric ozone…

Over forests, fields, orchards suffering from chlorosis (25-30% of total areas)



Carbon Dioxide Removal proposals…	Albedo Modification proposals… In the Stratosphere
… address the cause of human-induced climate change (high atmospheric GHG concentrations).	…do not address cause of human-induced climate change (high atmospheric GHG concentrations).
…do not introduce novel global risks.	… introduce novel global risks.
…are currently expensive (or comparable to the cost of emission reduction).	…are inexpensive to deploy (relative to cost of emissions reduction).
…may produce only modest climate effects within decades.	…can produce substantial climate effects within years.
…raise fewer and less difficult issues with respect to global governance.	…raise difficult issues with respect to global governance.
…will be judged largely on questions related to cost.	…will be judged largely on questions related to risk.
…may be implemented incrementally with limited effects as society becomes more serious about reducing GHG concentrations or slowing their growth.	…could be implemented suddenly, with large-scale impacts before enough research is available to understand their risks relative to inaction.
…require cooperation by major carbon emitters to have a significant effect.	…could be done unilaterally.
…for likely future emissions scenarios, abrupt termination would have limited consequences	…for likely future emissions scenarios, abrupt termination would produce significant consequences

Conclusions:

The ISA method uses mainly existing technology with limited investments costs

As performed in the lower troposphere instead of in the upper stratosphere, far from populated areas, and with a much shorter lifetime and faster reversibility, it will probably have better public acceptance than other SRM proposals and it is the cheapest of the CDR methods.

ISA is feasible because it currently occurs [6)] and has been the coolant of the numerous Ice Ages!

Can be immediately applied NOW, but can also be rapidly stopped in case of problem.

If power plants flue gas or other updraft power is not available, maritime transport of goods can do it!

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