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Synergy between ocean scalars: application to the improvement of SMOS maps

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Since the beginning of the satellite era it is well known that ocean scalars of different types can be used to identify ocean structures. Not only that: on the identified structures the values of ocean variables exhibit some degree of correlation. Although some schemes have been proposed to take advantage of these correlations, there has not been a systematic exploitation of the redundancy among scalars.

The introduction of singularity analysis for remote sensing maps of the ocean has shown that the correspondence among different scalars can be rigorously stated in terms of the correspondence of the values of their associated singularity exponents. The singularity exponents of a scalar at a given point is a unitless measure of the degree of regularity or irregularity of this function at that given point. Hence, singularity exponents can be directly compared disregarding the physical meaning of the variable from which they were derived. Using singularity analysis we can assess the quality of any scalar, as singularity exponents align in fronts following the streamlines of the flow, while noise breaks up the coherence of singularity fronts.

Taking the correspondence of the singularity exponents into account, it can be proved that two scalars having the same singularity exponents have a relation of functional dependence (a matricial identity involving their gradients). That functional relation can be approximated by a local linear regression under some hypothesis, which simplifies and speeds up the calculations and leads to a simple algorithm to reduce noise on a given ocean scalar using another higher-quality variable as template.