New singularity exponent products now available!

Since January 14th, 2013, CP34 distributes singularity exponent fields derived from OSTIA SST

For any given ocean scalar (SST, SSS, SSH, Chlorophyll Concentration and even Water Leaving Radiances) singularity exponents can be calculated. Singularity exponents are dimensionless (i.e., no units) measures of the degree of regularity or irregularity of a function at each of its domain points. They extend the concept of Holder exponents, so positive exponents imply that the function is continuous and has a given number of derivatives, while negative exponents imply that the function is irregular and it experiences transitions, jumps and eventually divergences to infinity.

For obtaining singularity exponents we follow the theory explained in Turiel et al., *Remote Sensing of Environment* (2008) and Turiel et al, *Journal of Physics A* (2008). The modulus of the gradient of the scalar is evaluated at each point in the domain. The resulting field is projected on a given wavelet at different resolution scales, such that the dependence of the projection on the resolution scale can be assessed by means of a log-log regression, the slope of which is the singularity exponent.

Singularity exponents derived from regular scalars such as SSS, SST or SSH are bounded below by -1, since they are finite variation functions (see Turiel & Parga, *Neural Computation* (2000)). They have no upper bound, although values beyond 2 are rare.

It has been verified (Turiel et al., *Physical Review Letters* (2005); Isern-Fontanet et al, *Journal of Geophysical Research* (2007); Turiel et al., *Ocean Science* (2009)) that singularity exponents derived from SST maps track with remarkable precision the streamlines of the general circulation of the ocean. In fact, there is some evidence (Isern-Fontanet et al, *Journal of Geophysical Research* (2007); Nieves et al, *Geophysical Research Letters* (2007); Umbert et al, submitted to *Remote Sensing of Environment*) that different ocean scalars have the same singularity exponents – what should be expected if singularity exponents are the result of flow advection, regardless of the specific process of any particular ocean scalar.

Singularity exponents derived from a SST map of an OFES simulation, compared to the velocity field

Singularity exponents associated to SSS map from the same OFES simulation as above, compared to the velocity field.

This correspondence of singularity exponents can be exploited to reduce the effects of noise and artefacts on a given scalar map using the information conveyed by the singularity exponents derived from a different, higher-quality map. We have implemented a numerical algorithm capable of using the singularity exponents of one scalar field to improve the quality of a different scalar field.

The singularity exponent product distributed here has been generated from the daily OSTIA SST product (downloadable at MyOcean webpage). The algorithm described above together with the OSTIA SST product are used to derive our L4 product, which outperforms the SMOS SSS L3 products. The resolution of this product has been degraded to one fourth of degree to match that of SSS L3 maps used to generate the L4 product.

Singularity exponent maps are also useful for front identification, eddy tracking and assessing mesoscale activity. For such reason we distribute them here along with the other products (for instance, to produce SMOS L4 SSS products using OSTIA SST products as template). You can access singularity exponent data here and browse their corresponding maps here. Visit also Available Products section to access to the complete catalogue of products.