Structural and Dynamical Quality Assessment of Gap-Filled Sea Surface Temperature Products

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Abstract

Previous studies that intercompared global L4 sea surface temperature (SST) analyses were centered on the assessment of the accuracy and bias of SST by comparing them with independent near-surface Argo profile temperature data. This type of assessment is centered on the absolute value of SST rather than on SST spatial properties (gradients), which is more relevant to the study of oceanographic features (e.g., fronts, eddies, etc) and ocean dynamics. Here, we use, for the first time, the spectrum of singularity exponents to assess the structural and dynamical quality of different L4 gap-filled products based on the multifractal theory of turbulence. Particularly, we intercompare five SST datasets, four of which combine observations from different satellites, and in some cases in situ temperature measurements, to generate daily gap-free (L4), optimally interpolated for these datasets) global SST fields. We have also included a single sensor L3 dataset that has a 3 day temporal resolution to increase global coverage. Singularity exponents represent the geometrical projection of the turbulence cascade, and its singular spectrum can be related to the probability density function of the singularity exponents normalized by the scale [1].

Our results reveal that the different schemes used to produce the L4 SST products generate different singularity spectra, which are then used to identify a potential loss of dynamical information or structural coherence. This new diagnostic constitutes a valuable tool to assess the structural quality of SST products and can support data satellite SST producers efforts to improve the interpolation schemes used to generate gap-filled SST products[2].

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References

[1] Turiel, A., Yahia, H., Pérez-Vicente, C. J. (2008). *Microcanonical multifractal formalism—A geometrical approach to multifractal systems: Part I. Singularity analysis.* Journal of Physics A: Mathematical and Theoretical, 41(1), 015501

[2] Gonzalez-Haro, C., Isern-Fontanet, J., Turiel, A., Merchant, C. J., Cornillon, P.(2024). *Structural and dynamical quality assessment of gap-filled sea surface temperature products.* Earth and Space Science, 11, e2023EA003088. https://doi.org/10.1029/2023EA003088

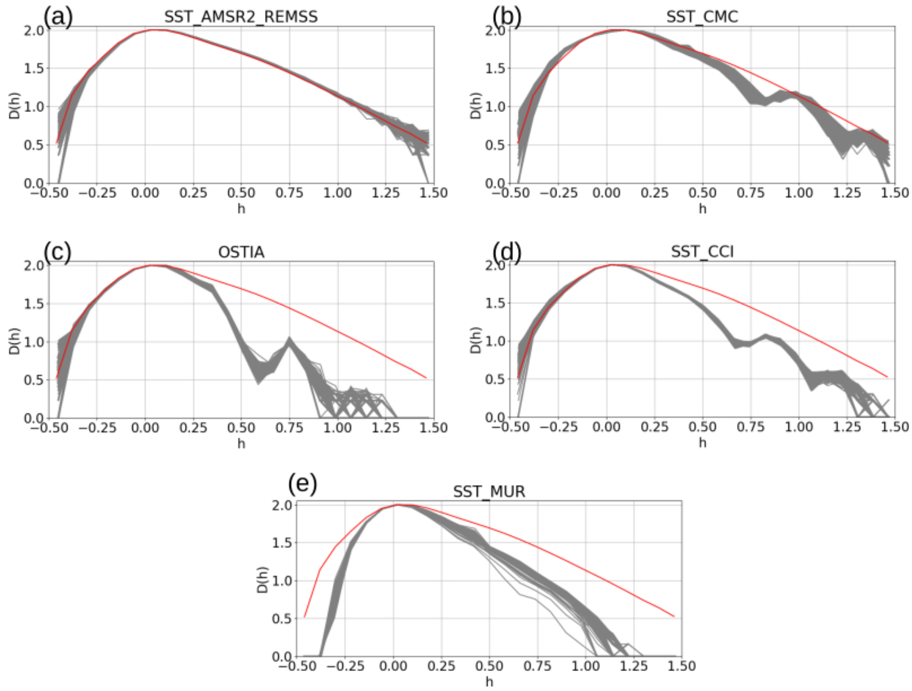

Figure 1: Singularity spectra $D(h)$, each gray line corresponds to a daily singularity spectrum of SST for: (a) AMSR2_REMSS, (b) CMC, (c) OSTIA, (d) CCI and (e) MUR. The red line corresponds to the median of the AMSR2_REMSS singularity spectra.