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General methodology for the derivation of high resolution oceanic data through information fusion at different scales

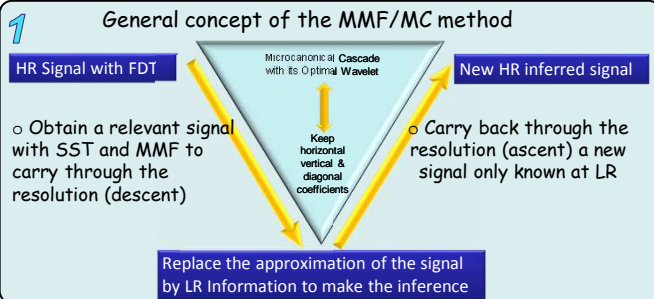


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Abstract

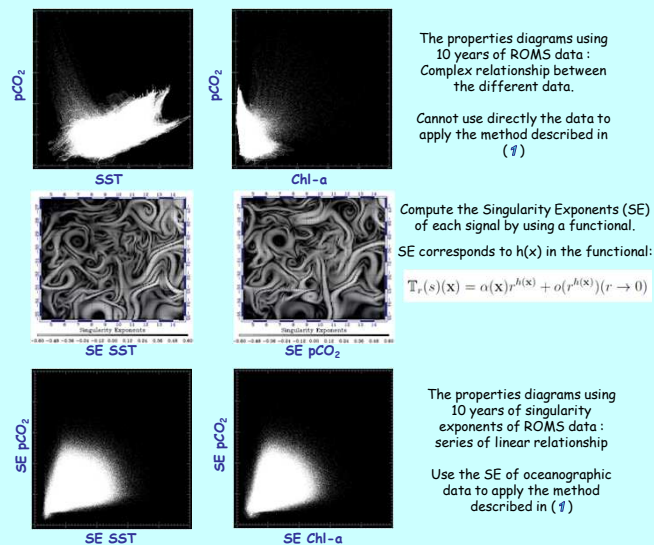
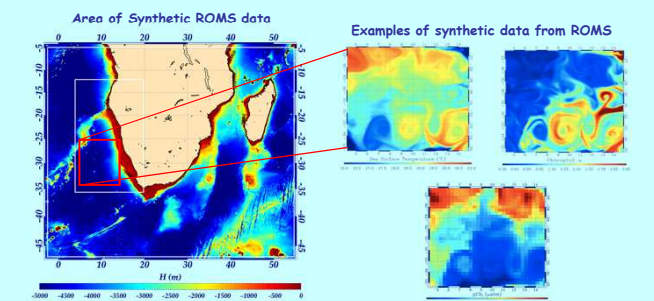
Derivation of high-resolution (HR) spatial distribution of data is a fundamental problem in Earth Observation. The problem can be solved through information fusion at different scales.

- New method based on an approximation of the energy of Microcanonical Cascade (MC), expressed in a Multiscale Microcanonical Formulation (MMF), for physical intensive variables of Fully Developed Turbulence (FDT) encountered in satellite Oceanography and Ocean/Climate interactions.
- The generality of the approach offers the opportunity to infer different oceanic turbulent signals from Low Resolution (LR) to HR. Basic idea:
 - optimal cascading to decrease the spatial resolution of the HR signal,
 - use the signal available at LR, transmit that information along the scales back to higher spatial resolution using the cascade to obtain a new HR signal.
- The process has been successfully used to obtain oceanic currents [1,2], oceanic partial pressure of CO₂ [3].
- Extension to many Essential Climate Variables both in the ocean and atmosphere critical for characterizing Earth's climate and its changes.



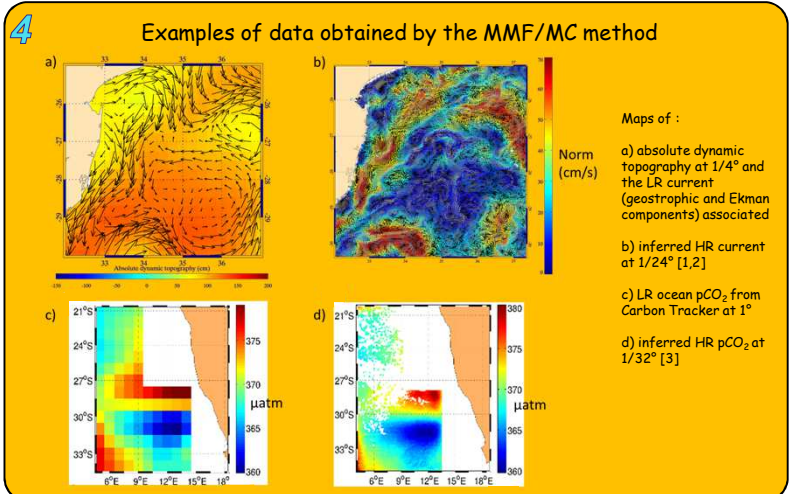
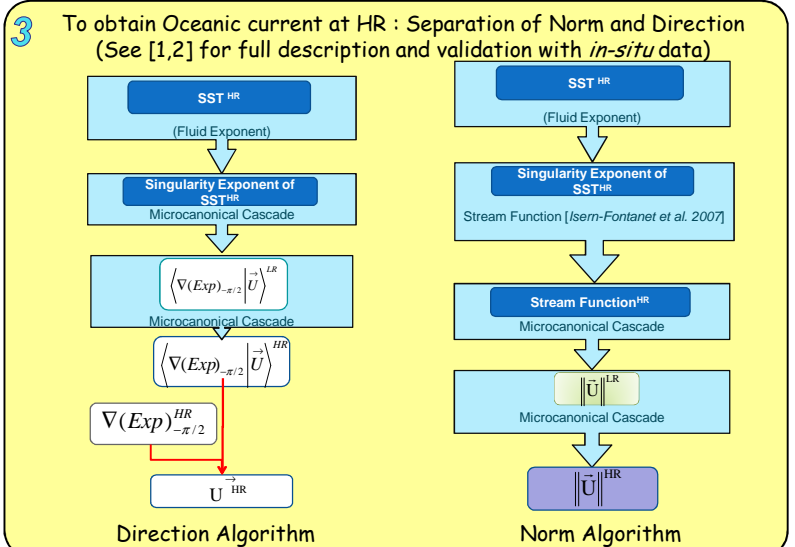
2 Relationship between the different oceanic signals:

To use the general concept (1), we need to verify the « linearity » between HR and LR signals.



Method to obtain HR pCO₂ using HR SST, HR Chl-a, LR pCO₂

- 1) $A(x) SE_{SST_{HR}}(x,t) + B(x) SE_{Chl_{HR}}(x,t) + C(x) SE_{pCO_{2LR}}(x,t) + D(x) = Proxy[SE_{pCO_{2HR}}(x,t)]$
 $A(x), B(x), C(x), D(x)$: coefficients of the multi-linear regression computed using Roms data
 - 2) Apply the general concept to the Proxy[SE_{pCO_{2HR}}(x,t)] :
 For each time t, compute SE of satellite data.
 Injection in the multi-linear regression above to obtain the Proxy[SE_{pCO_{2HR}}(x,t)]
 Use the proxy as « HR signal with FDT », and the pCO_{2LR} replace the approximation coefficients in the general concept.
- This method is fully described and validated with *in-situ* data in [3].



Conclusion and Future Work

- Evidencing multiscale geometric structures in synthetic ROMS data and satellite data through the Multiscale Microcanonical Formalism
 - Validation of algorithms on synthetic ROMS data
 - Application of the algorithms on satellite data
 - Validation of the new HR satellite data with *in-situ* data
- Future Work: Application of this general method for Altimetry (SWOT project submitted on OST-ST/TOSCA)

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