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Validity domains and parametrizations for white-noise and multiscale models in turbulence and wave-turbulence interactions

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Validity domains and parametrizations for white-noise and multiscale models in turbulence and wave-turbulence interactions

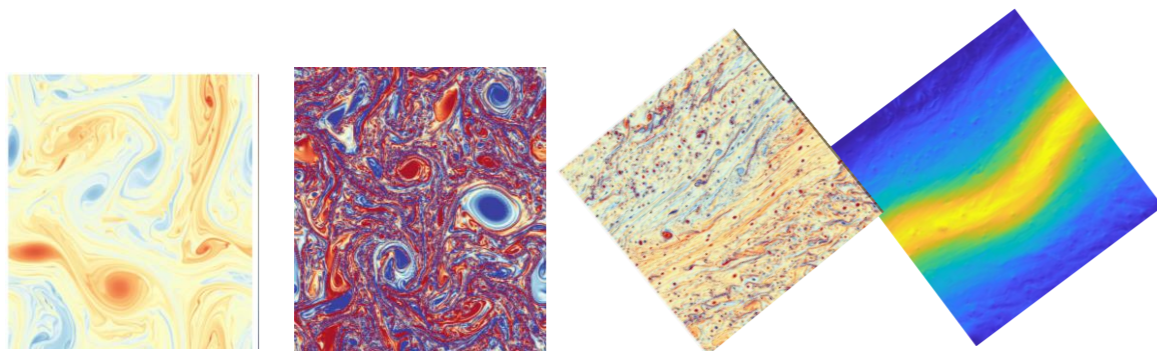
V Resseguier, E Hascoet, B. Chapron, B. Fox-Kemper

Validity of the time decorrelation assumption for v'
for turbulence / wave-turbulence:

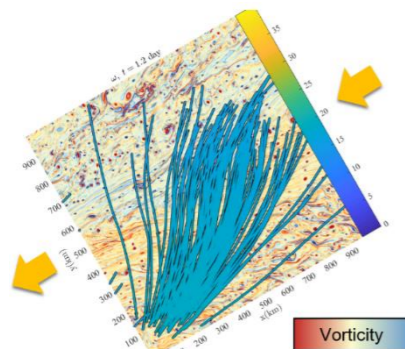
$$\frac{\left(\begin{array}{l} \text{Along-flow/ray} \\ v' \text{ correlation time} \end{array} \right)}{\left(\begin{array}{l} \text{characteristic time of} \\ \text{flow/wave group} \\ \text{properties evolution} \end{array} \right)} = \frac{\left(\frac{l_{v'}}{\|v\|/\|C_g^0\|} \right)}{\left(\frac{1}{\|\nabla v\|} \right)} \ll 1$$

Applied to

steep-spectrum (SQG) and flat-spectrum (2D Euler) dynamics;
homogeneous and heterogeneous flows

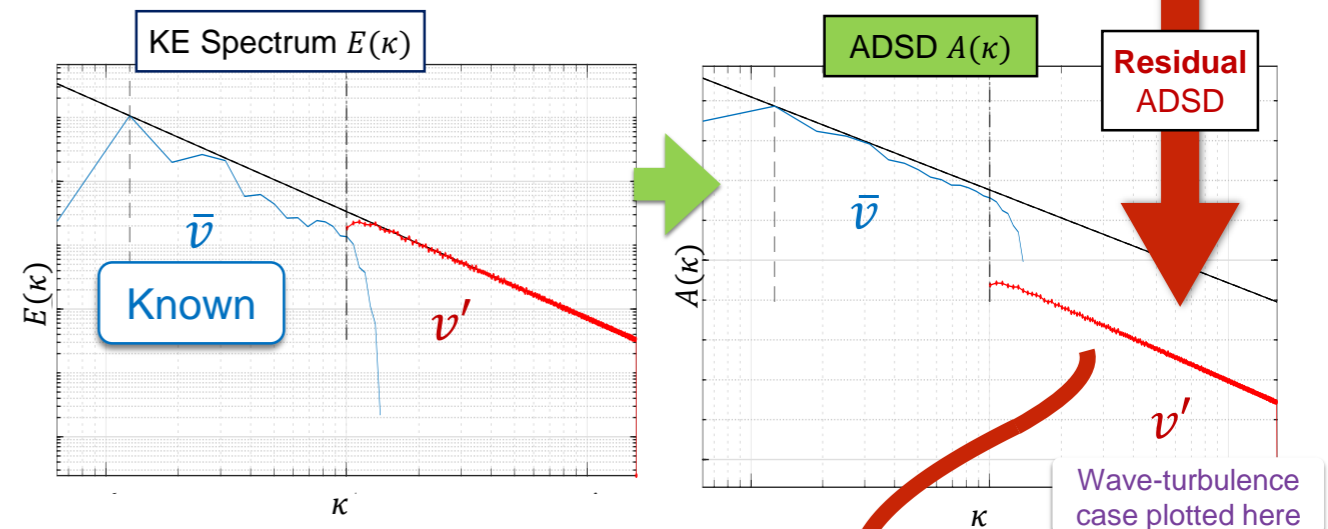
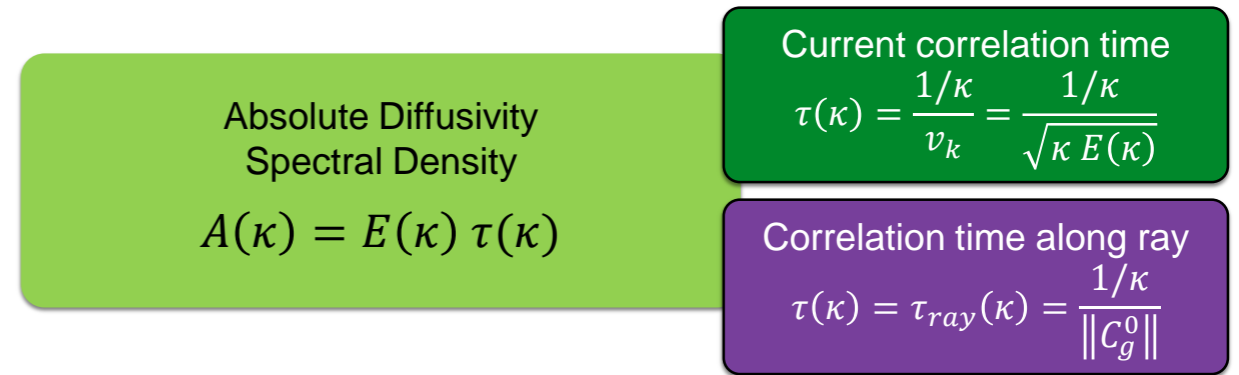


Example of ray tracing



Wave-spectrum,
Significant wave heights,
and Currents predictions,
Uncertainty quantification
for data assimilation

Parametrization of white v' for simulations



Reference:
Resseguier, Pan & Fox-Kemper, NPG, 2020

$$v' = (\text{filter}) * (\text{white noise})$$

Parametrization of v' multiscale in space and time are also possible