Multi-scale modeling of turbulent atmospheric motion in images

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Abstract. Based on physical self-similar models of turbulence, we propose in this paper a non-parametric multi-scale regularizer for optic-flow estimation in meteorological image sequences. Regularization is achieved by constraining motion increments to behave as self-similar processes characterizing turbulent flows. This hard constrained minimization problem is optimally solved by taking advantage of lagrangian duality. It results in a collection of first-order optic-flow regularizers acting at different scales. The regularization is combined with an observation term derived from the mass conservation law of atmospheric layers. The estimation is non-parametric since regularization parameters are inferred in the dual formulation and since the self-similar model hyper-parameters are selected in a second level of inference maximizing bayesian evidence. The performance of the resulting optic-flow estimator is evaluated on image sequences of simulated turbulent flows. The self-similar regularizer is then assessed on MSG image sequences.