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Accuracy of pathline predicates for flow visualization at the example of the benguela upwelling system

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Coastal upwelling systems transport nutrient-rich water to the upper layer of the ocean. These regions are especially important for marine life and fishery. We are using pathline predicates to create visualizations of the spatio-temporal structure of the Benguela upwelling system. Based on a 3D flow field of a regional ocean model, we first derive space-filling trajectories covering the full model grid. With pathline predicates, we select trajectories related to upwelling. Next, we derive a 3D scalar field representing the pathline density, which is visualized using volume rendering techniques. Further analyses of the pathlines show a distinct annual cycle in the upwelling activity, which fits well to observation-based analyses found in literature. These techniques and their application are described in [1].
In this work, we focus on evaluating the accuracy of our techniques. Based on the 3D ocean flow field stored at relatively coarse time interval, we compute trajectories to emulate a retrospectively derived tracer field. For different source regions, our data set contains several synthetic tracer fields directly computed within the ocean model simulation using the original short time steps that we can compare with our trajectory-based tracer field. With our evaluation we aim at determining minimum requirements for the temporal resolution of flow data for retroactively applying particle pathline techniques or visual analyses. By analyzing the skill in reproducing a synthetic model tracer field, we can set up rules for using the particle pathline methods in general.

[1] NARDINI P., BÖTTINGER M., SCHEUERMANN G.,
SCHMIDT M.: Visual Study of the Benguela Upwelling System using
Pathline Predicates. In Workshop on Visualisation in Environmental Sciences (EnvirVis) (2017), Rink K., Middel A., Zeckzer D., Bujack R.,
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