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On the analyticity of the trajectories of the particles in the patch problem for some active scalar equations

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Let Ω be a bounded domain in \mathbb{R}^n whose boundary is $\mathcal{C}^{1,\gamma}$ for $\gamma \in (0, 1)$. Consider $2D$ Euler equation for the vorticity or the nD aggregation equation in the case of the initial condition being a positive multiple of the characteristic function of Ω . In this paper we prove global in time analyticity of the flow generated by the velocity field which propagates the vorticity or density solution respectively.

These results are obtained from a detailed study of the Beurling or Riesz transform, that represents derivatives of the velocity field. The precise estimates obtained for the solutions of an equation satisfied by the Lagrangian flow, are a key point in the development.