Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Langmuir circulation without wind or surface waves: shear flow interacting with wavy topography[1] ANDREAS HOLM AKSELSEN, SINTEF Ocean, SIMEN Å. ELLINGSEN, Norwegian Univ Tech (NTNU) — Langmuir circulations in their traditional form are large rolling fluid flow pattern created by the interplay of surface waves and a near-surface shear current, typically both created by wind. Craik and Leibovich (1976) describe two kinematic mechanisms which cause instabilities which grow into Langmuir rolls, both involving only the interaction of mean current shear and wave motion. The same ingredients are present also in boundary layer flow over a wavy bottom topography.

We present a theory of Langmuir-like circulations (LLC) created by boundary layer flow over a topography pattern of two monochromatic waves crossing at an angle. Thus, the mechanissm often called CL1 is triggered, we describe it with the theory of Craik (1970), slightly modified.

A flow of arbitrary shear profile is assumed over the bottom topography. In the opposite limits of transient inviscid flow and steady-state viscous flow, simple equations can be derived and easily solved numerically. For the special case of a power-law velocity profile, explicit leading-order solutions are found. We map out the LCC response to varying wavelength, crossing angle and wave amplitude. The study is supplemented with DNS which verify the manifestation of LLC over wavy geometries with a no-slip boundary conditions.

[1]Research Council of Norway, grant 249740 (FRINATEK).

Simen Ellingsen
Norwegian Univ Tech (NTNU)

Date submitted: 12 Aug 2020 Electronic form version 1.4