A new airborne system for simultaneous high-resolution ocean vector current and wind mapping: first demonstration of the SeaSTAR mission concept in the macrotidal Iroise Sea

General comments

This manuscript presents the very first validation from real observations of the concept of squinted 3-look SAR along-track interferometry to retrieve the vectors of surface wind and total surface current velocity mapped at high resolution (200m).

The observations were collected with an airborne SAR system called OSCAR in a coastal environment characterized with high tidal flow. OSCAR is the airborne demonstrator of the Seastar satellite concept funded by ESA and based on the same principle of along-track interferometry from a 3-look squinted SAR.

Although based on a limited number of cases studied (two meteo-oceano situations, with one sampled under different flight geometries), the results are very convincing. The retrieved field of wind and surface current are validated against current fields from HF radar observations and from numerical model outputs.

So, the manuscript represents an important step in the assessment of this novel concept.

The manuscript is well organized and well written. Overall, it is a very good paper.

Specific comments

1- Retrieving the Total Surface Current Velocity is the main goal of the OSCAR and Seastar concepts. However, in the manuscript, the notion of TSCV is not defined: in particular does it include a motion component due to waves, in additional to what is classically defined as "current"? This should be clarified.

If it includes a component due to the waves, then in the validation, the comparison with surface currents from a numerical oceanographic model may not be fully appropriate because this latter does not include the wave component.

So more specifically, I suggest that the authors add some words on the definition on TSCV at the beginning of the manuscript (probably in the introduction) and that they add some discussion in the section 4 and/or 5 on the fact that (probably) wave effects are omitted in the current field from the numerical model whereas it is included in the retrieved TSCV.

2- The cost function defined to retrieved both the surface wind vector and the TSCV (Eq.1) is slightly different from the one presented in Martin et al, 2018 (which I copy below) . Indeed in this latter the GMF for σ_0 and for the Doppler anomaly is defined as a function of the wind relative to the current (u_{10}-c), whereas in the submitted manuscript, the current effect is not taken into account in the wind or current GMF model functions.

<u>From Martin et al, 2018</u>

$$J_{pp}(\boldsymbol{u_{10}}, \mathbf{c}) = \frac{1}{2N}\sum_{i=1}^{N}\left(\frac{\sigma^{0,pp}_{meas,i} - KuMod(\boldsymbol{u_{10}} - \mathbf{c}, pp)}{\Delta\sigma^0}\right)^2 + \frac{1}{2N}\sum_{i=1}^{N}\left(\frac{df^{pp}_{meas,i} - KuDop(\boldsymbol{u_{10}} - \mathbf{c}, pp) + 2.\, c_{//_i}.\, \sin\theta/\lambda_e}{\Delta df}\right)^2 \quad (1)$$

<u>From the submitted manuscript</u>

$$J(u_{10}, c) = \frac{1}{N_S + N_D}\sum_{i=1}^{N_S}\left(\frac{KuMod(u_{10}, \chi_i, \theta_i, p_i) - \sigma^0_{obs,i}}{\Delta\sigma^0_i}\right)^2 + \frac{1}{N_S + N_D}\sum_{i=1}^{N_D}\left(\frac{KuDop(u_{10}, \chi_i, \theta_i, p_i) + c_{||_i} - RSV_{obs,i}}{\Delta RSV_i}\right)^2 \quad (1)$$

I suggest the authors explain and justify this evolution or comment on this intertwined relation between wind and current in the GMFs.

3- The empirical model (GMF) used to express the Doppler anomaly due to the wave effects (WASV) is derived from the work of Mouche et al (2012). However, in the paper of Mouche et al, it seems that the model is limited to incidence angles less than about 40°, whereas the observations of OSCAR extend up to about 69° . So, for the inversion of OSCAR data, how is the GMF for the Doppler anomaly extended to the largest incidence angles (from 40 to 69°) ? This should be discussed.