General comments Indeed, this type of models are needed for coastal studies. And the general idea of having more efficient sensitivity analysis methods for this type of models is very attractive. But: the real benefits are not imminent from this MS, as the real details of both model and method are not described (i.e. not informative) - it is too easy to lay this MS aside as just another paper describing some sort of method. Remember that the people interested in using (the results of) this type of models are not necessarily interested in complicated sensitivity studies; what can you do to make their life easier?

Response 1: The goal of the current paper is to provide guidance to the setting up of the parameters for the vegetation model by performing sensitivity analysis. The paper does not detail the implementation details of the vegetation module because a referenced paper also published by the same group of authors (Beudin et al., 2017) contains the details of the implementation of the vegetation model. We have attempted to summarize the physical processes and related equations in Table 1 of the paper. While the Beudin et al. paper was able to describe the details of the vegetation module, as the Reviewer mentions, users need some guidance to "make their life easier" when choosing the parameters of a model. The present MS provides that guidance and evaluates the repercussions of the parameter choice through sensitivity analysis.

The chosen methodology of sensitivity analysis is detailed and cited in the Seshadri et al. 2017a paper of one of the co-authors, where more details as to what the subsampling strategy entails are provided. The computation of the Sobol' indices is outlined in Surdet et al., but is also provided in the appendix of the SIAM paper (Seshadri et al., 2017a). The purpose of the present paper is to demonstrate the computation of sensitivity metrics using an approach that is amenable to multi-physics simulations that are not computationally cheap.

In the new version of the manuscript we have modified the introduction and conclusions to clarify the idea of the paper. Specific additions to the text include:

"Page 2 Line 25-29 in introduction: "These tools are implemented in the open source package, Effective Quadratures Method (EQ) (Seshadri et al., 2017b) and the current work provides one of the first applications of this methodology to quantify sensitivity of input parameters in coastal models. Therefore, the goal of the present work is to take advantage of the EQ method to provide Sobol' indices that quantify the sensitivity of the flow and wave dynamics to vegetation parameters in COAWST model."

Page 10 Line 23 in conclusions: "We use a recently developed tool that formulates the Effective Quadratures method to quantify the sensitivity of plant input properties for the vegetation module in COAWST."

COAWST contains the word sediment, but the effects of vegetation on sediment are not mentioned in the abstract (or dealt with in the MS?)

Response 2: It is true that COAWST can model the transport of sediment. It is also able to model atmospheric conditions (WRF), but both sediment and atmospheric processes go beyond the scope of the present paper. The chosen output parameters for sensitivity analysis such as kinetic energy highlight the first order effects of introducing vegetation in the flow domain. While the model is capable of coupling the effects of vegetation with sediment model, the idea of the current study is not to model physical mechanisms due to the presence of vegetation. The focus of the current study remains to demonstrate the influence of vegetation parameter choice on the flow field. The resulting sediment transport effects are left for future work.

For the demonstration of this technique, seagrass properties -which can be measured quite well, i.e. do not have large uncertainty- have been varied over a relatively small range, whereas the environmental conditions have not been varied. Rather than learning which details matter, it would be interesting to see when (under which conditions) these details matter; try to compare the combinations of veg parameters to literature on flow regimes, e.g. Mitul & Nepf 2013.

Response 3: We believe the present work is relevant as it characterizes the sensitivity to seagrass properties because they do entail large uncertainty for measurement purposes and also exhibit a large range of spatial and temporal variability. Adding to the uncertainty, the seagrass growth is dynamic depending on nutrient supply, light quality and availability, and algal presence.

In Mitul & Nepf (2013), the focus is on creating situations ranging from blade scale to reach scale to understand the changes in resulting flow field. This kind of study is relevant for theoretical understanding of vegetation effects. The purpose of the vegetation module in COAWST is to be able to include the vegetation effects in realistic model applications for areas with known seagrass characteristics. The future goal is to use the model for the study of realistic changes in water level and wave attenuation triggered by the presence of vegetation.

My gut feeling says more uncertain parameters like C_d (=1 which is ok for a rigid cylinder, not for flexible, flat-bladed seagras!!) and z_0 can have stronger effects. Such considerations are mentioned in section 4.4, but should be discussed earlier to avoid loosing your public.

Response 4: We agree with the Reviewer that the sensitivity of drag coefficient can be studied. The determination of drag coefficient is usually done in controlled environments (laboratory scale). However, the purpose of the current work is to provide guidance for the vegetation parameters that are measured in physical systems and are required in the COAWST model for modeling the effect of seagrass. Variations on C_d are unlikely to be measured in the field and thus users could rely on the published literature for an appropriate choice based on the type, shape, and flexibility of the vegetation under study.

Following the reviewer's comment, we have added the reasons for not considering the input of C_d in the sensitivity of vegetation model in an earlier section on Page 6, Lines 2-6 (Section 2.3) as:

"In addition to these four vegetation properties, the vegetative model requires an input of drag coefficient (C_D) in the flow model and the wave model. However, variations on C_D are unlikely to be measured in the field and thus users could rely on the published literature for an appropriate choice based on the type, shape, and flexibility of the vegetation under study."

Why use pct change from the minimum value? That is a rather extreme situation.

Response 5: The thoughts behind using a minimum value is to show a relative change from each of the simulations with different vegetation parameters. Also, the mean of the simulations might not be as relevant, if response is non-linear.

Specific comments p2_l20 no drag coefficient or spatial density? Note that in the SWAN implementation (Suzuki et al), som parameters have exactly the same effect in the energy dissipation equations, see http://swanmodel.sourceforge.net/online_doc/swantech/node21.html.

Response 6: The bulk drag coefficient required in the SWAN parameterization in COAWST model assumes a constant drag coefficient. The spatial stem density is variable.

Following the reviewer's specific comments Page 4 line 16-17 include the following text:

"The parameterization of SWAN to account for wave dissipation implemented by Suzuki et al. 2012 has the same effect as energy dissipation."

p3_l1-15 what is the overall message of these loose examples?

Response 7: The overall message of providing previous literature on sensitivity studies involving physical systems is to lead to the idea that the choice of sensitivity analysis method depends on multiple factors such as computational costs, characteristics of the model, number of input parameters, and/or potential interactions between parameters.

The authors have rephrased the paragraph to make the context of providing the examples in the new version on Page 3 Line 12 to 18 in Introduction as:

"One of the challenges associated with a Monte Carlo approach to computing the Sobol' indices is the large number of model evaluations required for approximating conditional variance.

All these studies highlight various approaches to perform sensitivity analysis. Saltelli et al. (2008) provided a comparison of different sensitivity analysis methodologies and the optimal setup for specific combinations of parameters and model. Ultimately, the choice of sensitivity analysis methodology depends on multiple factors such as the computational cost of running the model, the characteristics of the model (e.g., nonlinearity), the number of input parameters, and/or the potential interactions between parameters."

p4 why not refer to Table 1 for the equations? p4_l29 , instead of ;

Response 8: We have added the reference to table 1 on page 4 in line 18 as:

"The parameterizations used to implement the effect of vegetation in both ROMS and SWAN models are mentioned in Table 1 and detailed in Beudin et al. (2017)."

p5_l28-31 is this the stem density or the leaf density? Typically, Zostera marina has multiple leaves, and as the stem is usually short it may be the leaves that interact with the flow. For leaf density, this is a very low number but it matches the diameter (=leaf width?).

Response 9: It is the stem density. Hence the units are stems/m^2. We have replaced the word "density" by "stem density" in the paper for clarity. The leaf width = diameter.

The thickness of the leaves is rather large in my opinion, given the small length of these plants. How has this been measured? With a caliper or estimated? (personal comm is not published data!

Response 10: This has been an estimation. Considering that the chosen range is large, even then the sensitivity analysis shows that thickness is not causing any changes to the flow field (i.e. the chosen model output parameters are the least sensitive to thickness).

Jeremy Testa is a Assistant Professor in the Chesapeake Biological Laboratory at University of

Maryland Center for Environmental Science. Some of the relevant literature of Jeremy Testa includes:

1. "Temporal responses of coastal hypoxia to nutrient loading and physical controls", Biogeosciences 6 (12), 2985-3008, 2009.
2. "The metabolism of aquatic ecosystems: history, applications, and future challenges", Aquatic Sciences 74 (1), 15-29, 2012.
3. "Submersed aquatic vegetation in Chesapeake Bay: sentinel species in a changing world", BioScience, Volume 67, Issue 8, 1 August 2017, Pages 698–712, 2017.

p18, Table 2 What about ah (as in Nepf, 2012)?

Response 11: In Nepf, 2012; "ah" helps in distinguishing the different flow regime where "a" is the frontal area per unit canopy volume. The canopy volume is based on the spacing between elements. The implementation of vegetation model does not work on the scales to resolve the spacing between the elements and only considers vegetation height "h" in the equations for modeling seagrass.

p20, Fig 1 Are the Drag force, mixing and streaming calculated by the vegetation module? I would think these are hydrodynamic properties computed by ROMS, based on the same set of veg eparameters that go to SWAN.

Response 12: This is absolutely correct. The equations of drag, mixing and streaming computed in ROMS use the same vegetation parameters as SWAN. There are two parts of the vegetation module, one in SWAN and one in ROMS and the two exchange information in the coupled system, thus resolving the wave-current modifications.

p28, in caption: where can I find the conditions for these sims?

Response 13: The different simulations are characterized by varying the vegetation properties (mentioned in Table 2.) while keeping the baseline setup similar in all cases for the purpose of studying their sensitivity. The discussion on the choice of the vegetation properties is detailed in Section 2.3. The domain setup, initial, and boundary conditions are the same for all simulations (except for the variation of vegetation properties). This setup is described in details in Section 2.4 (and schematically described in figure 2).

I am surprised the classical S shape for flow in/over canopies is missing

Response 14: The reason we are missing a S shape in the flow in/over the canopy is because the chosen vegetation stem density range is not large enough to cause that shape. The original paper showing the vegetation model implementation by the current authors (Beudin et al., 2017) shows this shape when a vegetation stem density of 2500 stems/m^2 is chosen (Figure 4a).

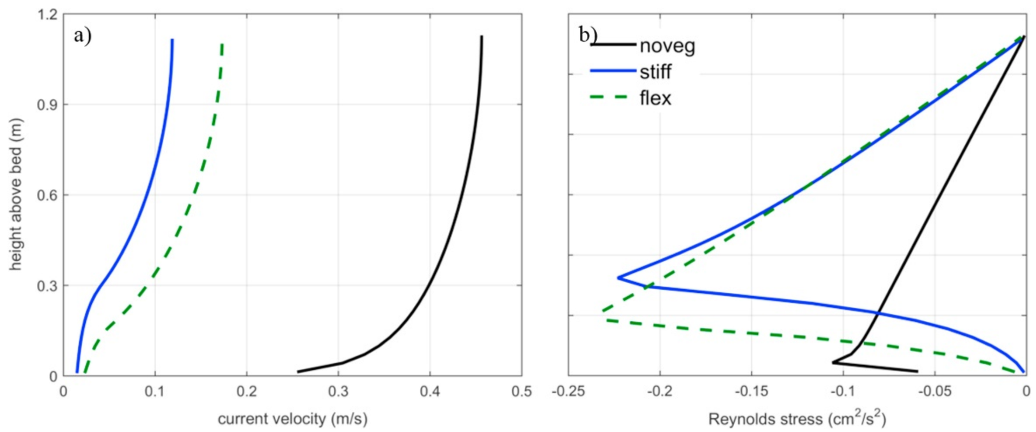

Figure adapted from Beudin et al. (2017) showing vertical profiles of a) mean flow velocity, and b) turbulent Reynolds shear stress ($\overline{v'w'}=-KM\delta v\delta z$) in the middle of the patch at peak flood without vegetation (solid black), with stiff vegetation (solid blue), and with flexible vegetation (dash green).