To the authors (Wang et al.)

The authors aim at interpreting in-situ pump data from the DYFAMED station in the Mediterranean Sea. For this purpose they propose a model including aggregation and disaggregation of particles of two size classes, respiration, degradation and sinking. Data and model values are considered at 7 depth levels. The model parameters are estimated in two steps by an Bayesian approach.

At the time of sampling (May 2005) the particle numbers in the water column are very low and thus I doubt that aggregation would have played a significant role in particle dynamics. Aggregation of particles is an essentially non-linear process (because particles have to meet in order to aggregate) and thus in my opinion a linear term for the description of aggregation is highly inappropriate. Further, the authors make a steady-state assumption without justification or further discussion. Application of the estimated ('optimal') parameters in the various model equations yields no convincing support for the steady-state assumption. The whole text seems to be largely driven by methodological aspects (Bayesian approach) and neglects a discussion of the data and the estimated model parameters (are the estimates plausible/do they make sense?). Given the deficits in the model formulation ('linear aggregation', 'steady-state') and the question whether the data used contain valid information about the processes included in the model, I could not see what a reader can learn from this investigation and thus I do not recommend publication in Biogeosciences.

Further remarks:

Abstract: "The estimated aggregation and disaggregation rate constants were $7.65 + 3.35 - 2.33$ (0.13 yr) and $106.09 + 39.13 - 28.59$ yr^{-1} (0.01 yr), respectively, which indicates that particle aggregation and disaggregation were extensive at the studied depths (125-750 m) in May after the spring bloom had ended and flux was low."
Disaggregation is faster (lower time constant: 0.01 yr) than aggregation (time constant 0.13 yr) and thus one would expect less and less aggregates.

p. 1 L19 Stoke's law $\Rightarrow$ Stokes' law
(named after George Gabriel Stokes)

p. 2 L5-7 ″3) dissolved thorium activity is orders of magnitude higher than particulate activity, thus in models, dissolved thorium influences the adsorption-desorption balance more than particulate thorium does (Wang et al., 2016).″
Not clear to me: ′What is the disadvantage here?′ A problem for models only or also for the real world?

p. 2 L16 ″Wang et al. (2017) compared rate constants ...″
Rate constants: for which process(es)?

p. 2 L18-20 ″There were clear differences: aggregation and disaggregation rate constants estimated from chloropigments were orders of magnitude higher than those from thorium tracers. These results were thought to be due to the differences in the way thorium and chlorophyll exist on and within particles.″
Not clear, what authors like to tell us.

p. 2 L26-29 this should be dropped: ″... since traditionally it is thought that aggregation is the process of small particles colliding with other particles and becoming larger, and disaggregation is the process of larger particles breaking up into smaller particles. Whereas, particles in fast sinking categories are a combination of large and small particles, because some small particles have high sinking speed, and vice versa ...″

p. 3 L12-13 ″These inter-comparisons enabled us to investigate whether sampling techniques or the tracer itself imposed a stronger constraint on modeled rate constants.″ ???

p. 3 L17 (4320′N, 740′E) $\Rightarrow$ (43°20′ N, 7°40′ E)

p. 4 L16 ″If we discrete ...″ $\Rightarrow$ ″If we divide ...″

p. 4 L27-28 ″We assume first-order reaction kinetics for aggregation and disaggregation, which is a gross simplification since the real reaction kinetics is not known.″
If the real reaction kinetics is not known, then it is not known whether first-order reaction kinetics is a gross simplification.
The kinetics of aggregation of biogenic marine particles has been described by Jackson (1990) and many others: it is essentially non-linear (because particle have to ′meet each other′ in order to aggregate). The kinetics depends on size, sinking speed, stickiness of particles (for details compare, for example, Jackson, 1990).

p. 5 L1 "We thus use the same mathematical method and conceptual model found in other published studies ..."
Used methods (including first-order reaction kinetics for aggregation) have to be justified based on theories (first principles) and/or observations; reference to 'other published studies' is not enough.

p. 5-6 "Here we assume the system is at steady state, just as has been done in Wang et al. (2016, 2017) and almost all similar work, e.g.(Murnane et al., 1990; Clegg and Whitfield, 1991; Marchal and Lam, 2012; Lerner et al., 2016, 2017), to make the results comparable."
The steady state assumption is not sufficiently justified (again: reference to 'similar work' is not enough).

p. 7 L6 "hyperv paramter" ⇒ "hyper parameter"

p. 7 L7-8 "Typically, we obtain the optimal parameters in less than 50 iterations." 'Iterations' is mentioned here for the first time. What is iterated?

Table 2: typo: $\beta \Rightarrow \beta_1$

References

[1] Jackson, G.A. A model of the formation of marine algal flocs by physical coagulation processes. *Deep-Sea Res.*, 37(8):1197–1211, 1990.