



September 3, 2020

This memo summarizes the rationale for the decision on 1 September 2020 to postpone the pilot campaign for the Sub-Mesoscale Ocean Dynamics Experiment (S-MODE). After delaying the pilot campaign from April 2020 because of COVID-19 issues and travel shutdowns, we had set September 1 as the day to make a formal go/no-go decision for conducting the pilot campaign in October-November. We chose September 1 because it is when we would start to incur irrecoverable costs from preparing for the pilot campaign.

Executive summary: We decided to postpone because there was an unacceptably high risk that COVID disruptions would make it impossible to align the aircraft and in situ parts of the experiment.

The ~12-day pilot campaign involves several components:

- (1) a UNOLS cruise (on R/V *Oceanus*), that would conduct surveys and deploy autonomous platforms
- (2) a B200 aircraft from NASA Armstrong Flight Research Facility (AFRC) carrying instruments from JPL and UCLA
- (3) a Gulfstream-III aircraft from NASA Langley carrying the JPL instrument PRISM
- (4) a Twin Otter aircraft from Twin Otter International, Inc. carrying the Scripps MASS instrument suite
- (5) 8 underwater gliders from the US Naval Oceanographic Office, deployed from the MV *Shana Rae*
- (6) 6 Saildrones sailing from San Francisco Bay.
- (7) 4 Wave Gliders (deployed from *Oceanus*)
- (8) Drifters and Lagrangian (water-following) floats (deployed from *Oceanus*)

As part of our COVID-mitigation planning, the S-MODE Science Team had discussed the minimally acceptable pilot campaign (i.e., the most reduced-scope campaign that would be worth conducting). The minimally acceptable pilot campaign had the goal of making simultaneous measurements of surface currents from the DopplerScatt instrument (item 2) with surface current measurements from items 4, 6, 7, and/or 8. *Therefore, the DopplerScatt instrument on the NASA AFRC B200 was a critical component of the pilot campaign.*

In considering whether to execute the pilot campaign, the most important consideration was the safety of all involved. The ground rules we set for making the go/no-go decision were that we would not conduct the campaign unless all participants and participating institutions were satisfied with the health and safety plan. We also had to weigh the risk that the pilot campaign would be



unsuccessful or would need to be cancelled at the last minute or mid-campaign, after significant project resources had been spent.

We worked extensively on the safety plan and had a viable path that was acceptable to those involved. The plan for the UNOLS cruise was based on previous successful cruises in the COVID era and was seen as one of the least risky parts of the campaign. The health and safety plan for the NASA B200 was more tenuous because NASA AFRC safety regulations—guided by FAA regulations and industry standards—prohibit the pilots from wearing masks during flight. At the same time, operations require two pilots to sit in a confined space less than 6 feet from two instrument operators for several hours at a time. In formulating the B200 COVID safety plan, all agreed that the instrument operators should wear N95 respirators and face shields, but some participants were not comfortable with this as the sole safety measure. Another option discussed was a quarantine and testing regimen, like the one used for UNOLS ships (e.g., 14 days strict isolation and 3 tests before fieldwork, and continued strict isolation during fieldwork), but the participants/institutions could not support strict isolation prior to the fieldwork. We reached a tentative agreement on using daily testing of participants, together with reasonably strict social distancing—this scheme required a short test turnaround (<1 day) to be useful. (The gold-standard PCR tests are taking variable amounts of time for results, on the order of a few days.) We identified only one testing provider in the San Francisco area that could deliver the required short turnaround with an accuracy comparable to a PCR test (a Cepheid molecular diagnostics test). We have not yet been able to obtain a verbal commitment from the testing provider to support S-MODE.

If we were to conduct daily testing of 5 pilots/operators for 16 days (starting a few days before the campaign), it would be 80 tests. In an email, the NASA Ames Chief Medical Officer (CMO) relayed a discussion he had had with the AFRC CMO that expectations for false positives should be 3-6 for every 50 tests. (If we assume the more optimistic false-positive rate of 4%, it would be 2 false positives for 50 tests.) So one major risk of this plan is that operation of the one critical instrument in our 12-day campaign would be interrupted by 3-9 false-positive COVID test results. We had not worked out how we would handle a positive test result, but the minimal response would be to halt operations for one day. The initial assessment of the NASA AFRC Chief Medical Officer and the Ames Chief Medical Officer was that a positive Cepheid test should be followed by a PCR test and quarantine of all close contacts, which could mean a few more days of downtime. The prospect that this could be expected to happen 3-9 times during a ~12-day campaign was seen as a critical risk.



We also considered the following factors:

- We conducted a survey of all participants (ship science crew, aircraft pilots, aircraft instrument operators, aircraft ground crews), and the results indicated some discomfort with proceeding, but willingness by all involved. We had repeatedly iterated the plan with some participants who felt uncomfortable, and I was concerned that these participants were feeling pressure to proceed.
- The risk associated with a second wave includes the possibility that the campaign would be cancelled after significant expenditures because of new lock downs or travel bans in California or at the NASA centers or participating universities/institutions.
- There is no pressing scientific or financial reason to conduct the campaign in 2020.
- The B200 instrument integration has been slowed by COVID-related issues. The schedule is tight and could be disrupted.
- The NASA Langley Gulfstream-III aircraft became unavailable for the S-MODE pilot campaign around August 26 because of COVID-related schedule changes (related to quarantine requirements for a higher-priority mission).

Considering all of these factors, the risk of a failed campaign (inability to conduct the minimally acceptable pilot campaign) was significant, with potentially catastrophic cost impacts (>\$3M). Delaying the pilot campaign is not without cost and inconvenience, but it presents much lower risk and leaves S-MODE well positioned to execute a successful pilot campaign under more favorable conditions.