Summary WG Round 2 – Rates.

Summary of Primary Production Methods:

We started by summarizing details of primary production methods to identify differences between sites that we’d have to address in any effort to intercompare. Most sites used 14C, but there are substantial differences in incubation conditions/duration.

BATS – in situ 14C, dawn/dusk, triplicate light bottles, dark bottle, GF/F filters, reported as mgC/m3/d

HOT – in situ 14C, dawn/dusk, triplicate light bottles, NO DARK BOTTLE, GF/F filters, reported as mgC/m3 – no time unit.

SPOT – no PP

Epea – 13C, single morning PE curve scaled to integrated to daily light dose, light/dark vials, GF/F filters, reported as mgC/m3/d

Ubatuba – 13C, short (several hour) simulated in situ production incubation scaled to photoperiod based upon fraction of photoperiod and irradiance covered during incubation, light/dark bottles, GF/F filters, reported as mgC/m3/d.

CalCOFI – 14C, noon to dusk simulated in situ, multiplied by scalar to get to equivalent of 24h incubation, light/dark bottle, HA19 (?) filters.

IMARPE – 14C (but want to move to 13C for logistical regions), 24h simulated in situ incubation scaled to fraction of daily irradiance, light/dark bottles, GF/F filters

NEPTUNE/Canada – 13C simulated in situ incubations now started when arriving at station regardless of time of day, formerly done as 24h dawn/dawn incubations.

Recommendations:

Many time-series have time constraints that require short incubations (short cruise overall or not at a single station long enough), which impacts intercomparability. It was also decided that none of the represented time-series used the best method – identified by our working group. The best method was agreed upon based upon both a desire to intercompare data AND the lack of standard.

The recommendation is that the BEST method is: a 24h dawn to dawn in situ incubation, with a dark bottle incubation and GF/F filters. Bottle size was also discussed and decided that >250ml is just fine, but clearly would be larger for 13C incubations. It must be noted a caveat that GF/F’s may adsorb some DOC14 produced in the incubation and so be mindful that it might not be truly particulate primary production. Most call it 14C Primary Production which leaves enough ambiguity, but still must be aware of what is measured.

A GOOD method is: 24h dawn to dawn simulated in situ incubation, also with a dark bottle incubation and GF/F filters.

It is further recommended that each time-series due this BEST incubation once to know how their regular protocol compares to the BEST and so that each generate a ‘correction’ as a first step in the intercomparison.

A significant reason for standardizing the incubation conditions is because of the simple fact that as a rate we don’t have, or foresee having, an analytical standard. Therefore to get at intercomparability we have to remove all the other inconsistencies save for source of the sample.

It is generally thought that 14C and 13C methods, when incubations are consistent, give similar results, but this is based on research conducted by other groups than the time-series. It is recommended that for those sites who can use both isotopes that more direct comparison incubations be done to address the intercomparability between time-series using different isotopes.

Furthermore, based upon continued logistical hassle with 14C, there was a general idea that we should consider making a recommendation to shift to 13C, of course this could only be done with sufficient and documented intercomparison.

Second order recommendations: report in units of massC/volume/day, and use a uniform ‘euphotic zone’ depth of 0.1% of surface irradiance. This is more due to integrating all the autotrophic biomass, as at deepest depths, both BATS and HOT find that there is rarely a significant difference between light and dark bottles. Recommendations for ancillary data, post daily integrated irradiance.

Comment on Cleanliness. This was a mixed discussion. There was consensus that cleanliness and caution was needed. However, it was suggested that each time-series check their cleaning protocols to determine appropriate protocol. This was brought up based upon observations that at both BATS and HOT that our regular Nisken samplers were as Fe clean as go flows. For BATS we’ve also compared rates in both bottle types and are confident in the transition.

Comment on centralized analysis centers. Many countries that have problems using radioisotopes may not have the resources to run and maintain an IRMS for 13C so it was briefly mentioned to use a core facility like UC-Davis. Obviously can’t force this but time-series should consider this.

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Bacterial Production:

Far fewer representatives.

SPOT – light short deckboard incubation, mix of Leucine and Thymidine, all at SST regardless of depth

HOT – dawn/dusk in situ incubation, light/dark bottles, leucine, in situ T

BATS – short (4-6h) dark deckboard incubation, Thymidine, at +/- 2oC of sample temp,

Short discussion, but main concern was what does the measurement mean. For example, at HOT very clearly show that Prochlorococcus takes up Leucine in the light, unknown in the dark.

Recommendation was to conduct measurements as BATS does.

**Dark, short, mix of isotopes – best incubation protocol.**

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Other rates and measurements:

Minimal discussion and left as specific to the system studied/question asked.

One exception is measurement of NCP by oxygen. We discussed this at some level and all agreed that it is important to have this number but it won’t replace direct measurements of primary production. Our recommendation is that if possible measure directly primary production and NCP by oxygen.

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Technology:

A technology that continues to advance, but isn’t quite there yet is FRRF. It measures electron transport through Ps and then must make assumptions as to how this translates to carbon fixation. This has high potential due to non-destructive and rapid analysis, but needs further calibration/assessment relative to 14C methods.

Triple Oxygen Isotopes: used in a number of different locations and gives several different rates, namely GPP, NPP, and can do NCP. However, the total number of direct comparison datapoints are still low so need further validation.

Both of above are non-incubation dependent and fundamentally reflect what has happened before you arrived at station, whereas 14C/ 13C are incubation based and so measure what happens after you put a sample in a bottle. There are pros/cons of both, but clearly need further validation.

Difficult to rate these two as better/good/acceptable at this point, but both have large upsides.