

# Match Up Options

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## Questions:

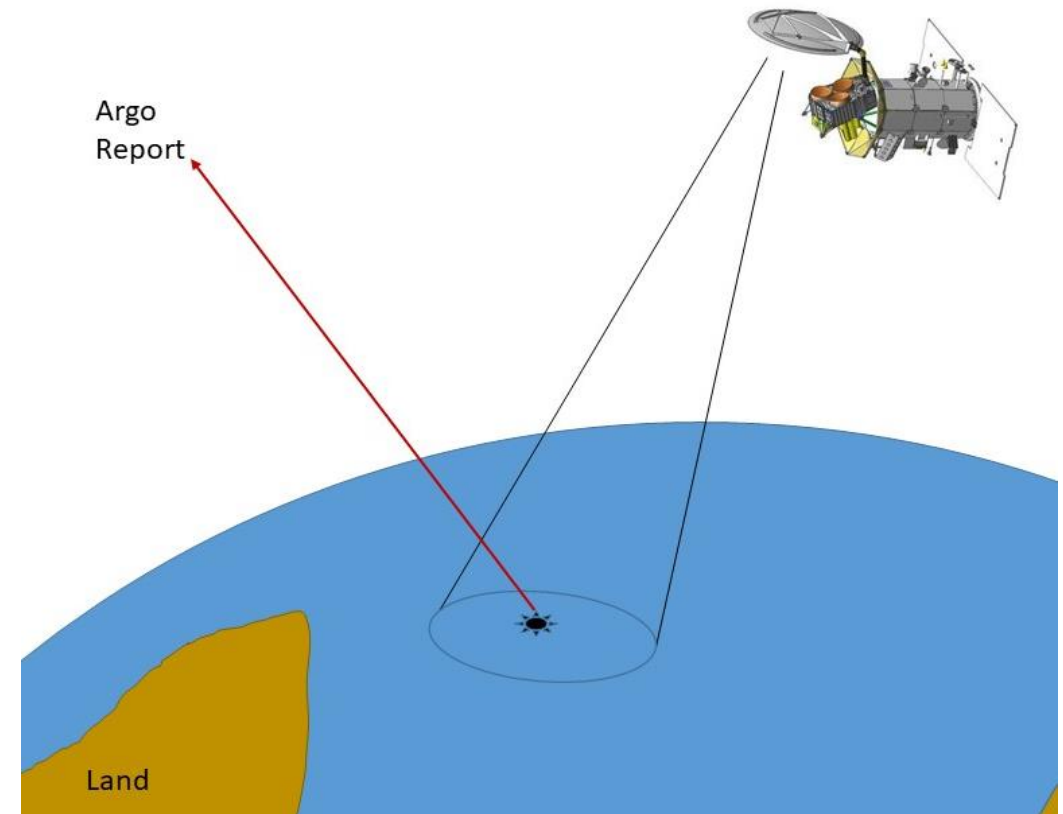
Best choice for SMAP ?

Should we reconsider Aquarius ?

How to work with PI-MEP ?

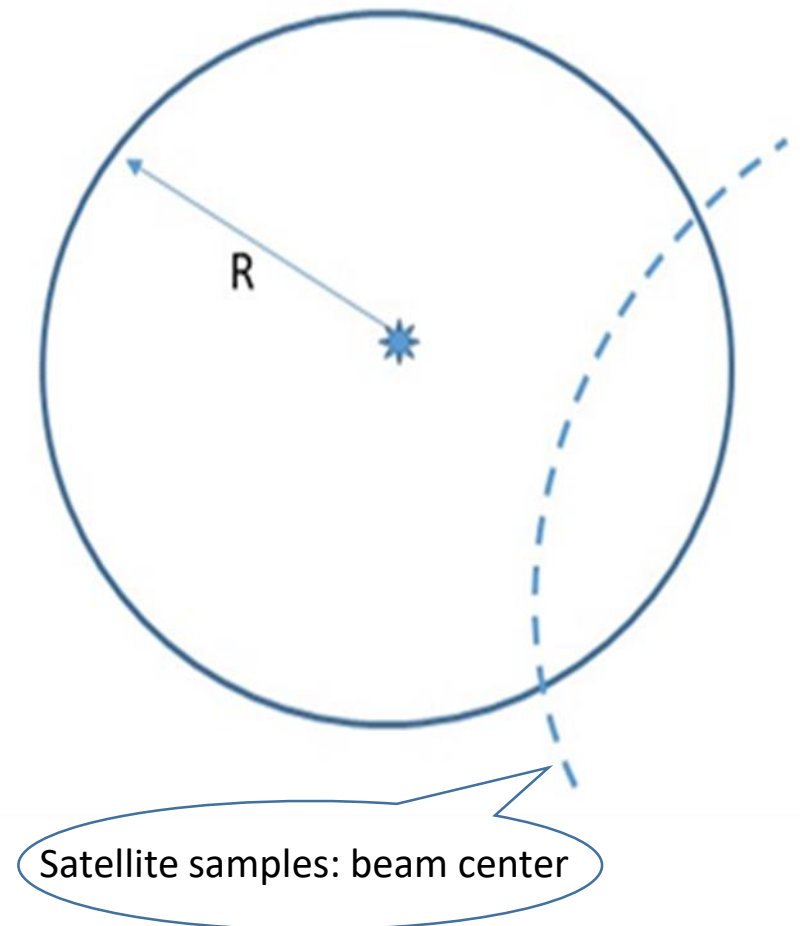
# Definition of “Match-Up”

- What:
  - $\Delta SSS$  = difference of satellite and in situ SSS
  - Used for validation and/or calibration
- Issues:
  - Spatial resolution
    - Point surface measurement
    - Large footprint of satellite observations
  - Accuracy
    - Satellite data is over sampled
    - Single observation (e.g. 1.44 sec for Aquarius) are noisy compared to goal
  - Frequency
    - Coincidence of Argo surfacing and satellite boresight unlikely
    - Doesn't occur often enough to get reliable statistics



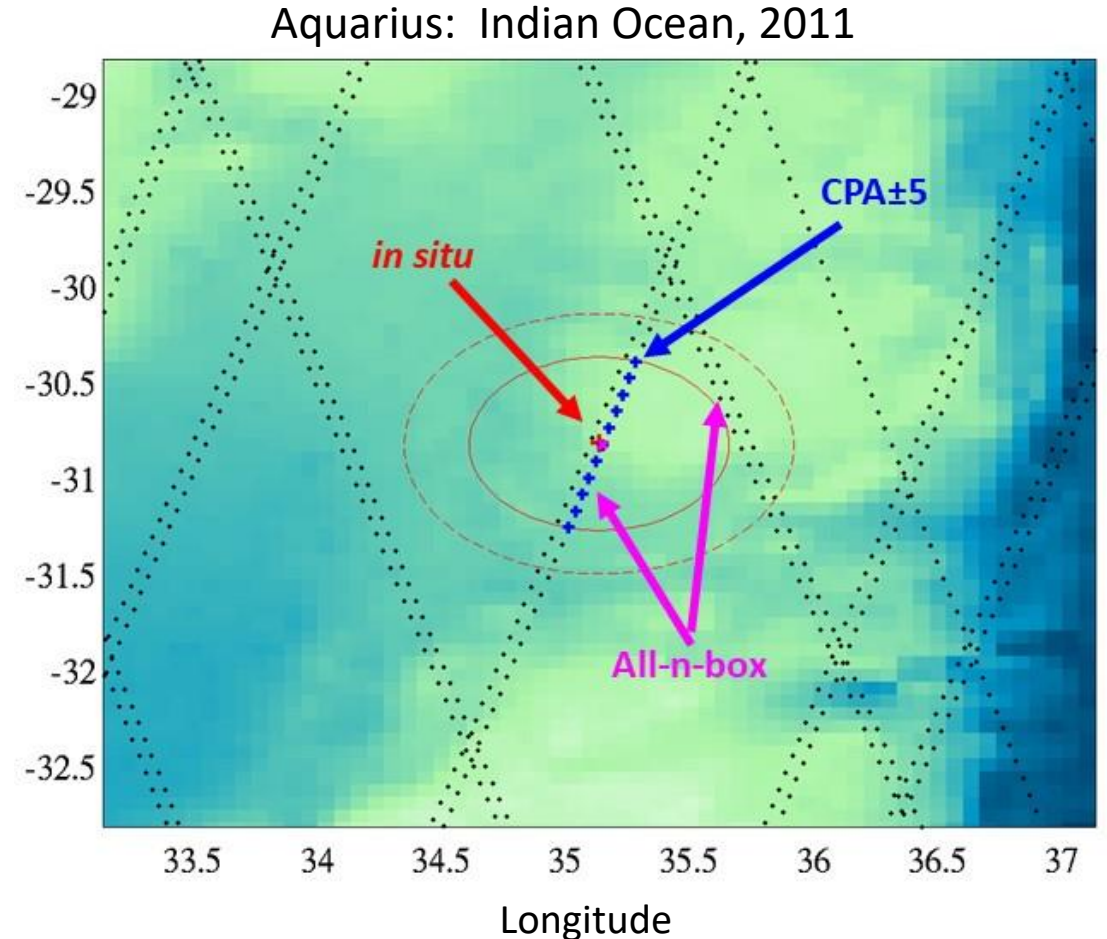
# Definition of Match Up: Practical Options

- Practical Definition
  - Coincidence within Time-Space Neighborhood
    - Space: Circle of Radius  $R$
    - Time: within  $\pm T$  of in-situ observation
- Options
  - CPA: Closest point of approach
    - CPA: closest in space and/or time
    - Single samples are noisy (satellite data over sampled)
  - CPA  $\pm N$ : Closest point of approach with averaging
    - Reduces random noise
    - May include samples outside time-space box
  - All-in-Box: All samples in time-space box
    - Reduces noise (but not uniformly)
      - Number of samples per box may vary
    - Consistent with time-space box



# Examples of Match Up Definition

- CPA  $\pm$  5
  - Example: Aquarius
  - Space: R = 75 km
  - Time:  $\pm$  3.5 days
- All-in-Box
  - Example: Aquarius-GSFC data base\*
  - Space: R = 25 & 75 km
  - Time:  $\pm$  0,5,  $\pm$  3.5,  $\pm$  15 days
- CPA: Single Sample
  - Example: PI-MEP (Aquarius L2)
    - Single sample (closest in time and space)
  - Space: Circle of  $\frac{1}{2}$  footprint: 50 km
  - Time:  $\pm$  12 hours



\*E. Dinnat: <https://neptune.gsfc.nasa.gov/csb/data>

# Problem Using Single Sample: Noise

- Assume:

- Each sample =  $\langle \text{SSS} \rangle + \text{noise}$
- $N =$  zero mean with STD,  $S_n$
- $N$  of each sample = independent

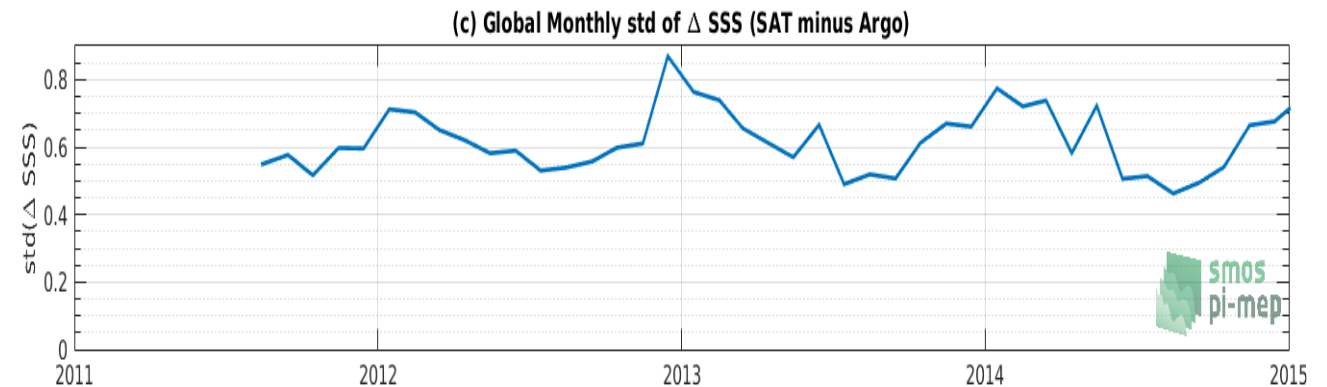
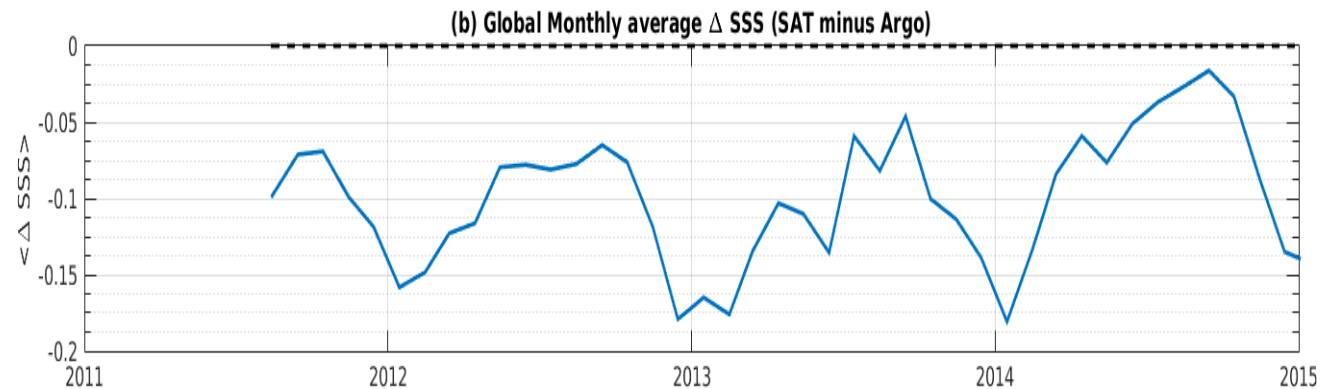
- Then

- Noisy samples not issue for mean
- $\langle N \rangle = 0$

- But

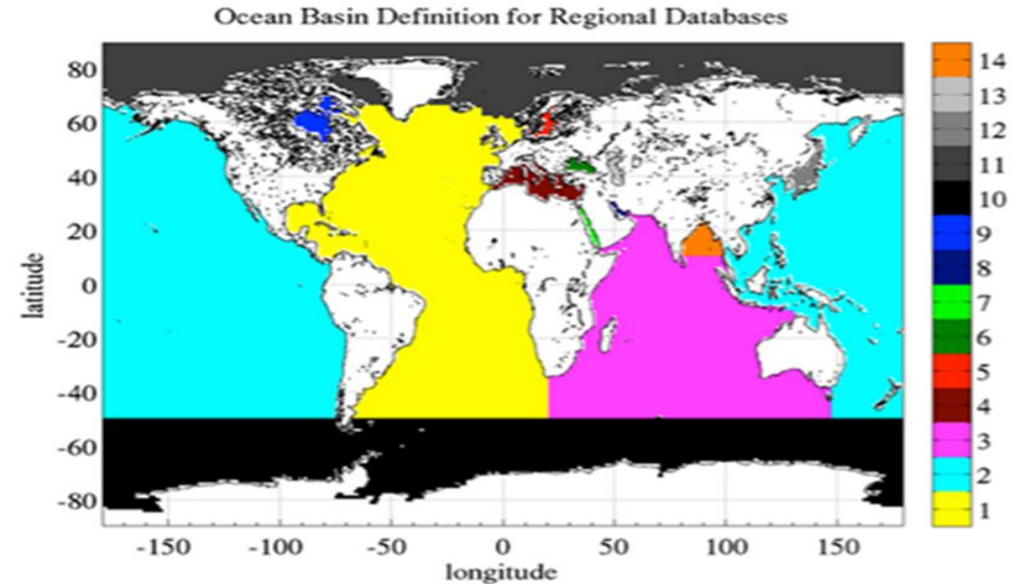
- Variance increases:  $\sim \langle N^2 \rangle$
- $\text{Var}(\Delta \text{SSS}) =$   
 $= \text{Var}(\text{SSS}_{\text{argo}} - \langle \text{SSS}_{\text{aq}} \rangle) + \text{Var}(N)$

Example: PI-MEP Aquarius L2



# Effect of Space-Time Box & Choice of samples

- Space-Time Box
  - Space:  $R = 25, 75 \text{ km}$
  - Time:  $\pm 0.5, \pm 3.5, \pm 15 \text{ days}$
- Samples
  - ~~CPA (one sample)~~
  - CPA  $\pm 5$
  - ALL-in-box
- Aquarius Data
  - E. Dinnat data base
  - <https://neptune.gsfc.nasa.gov/csb/data>

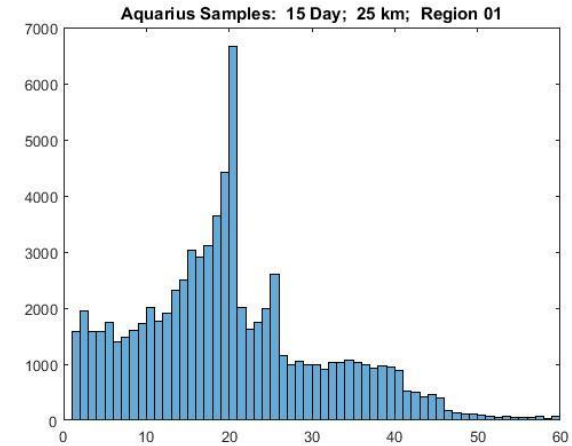
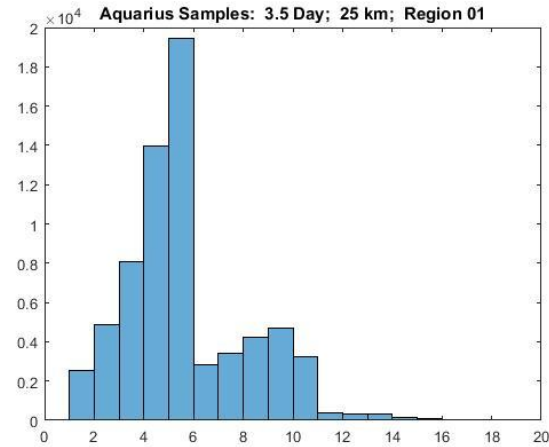
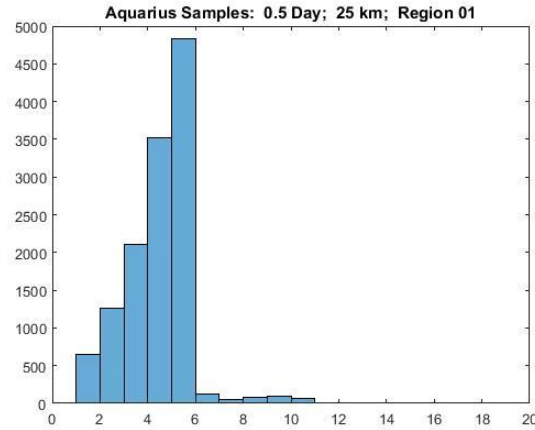
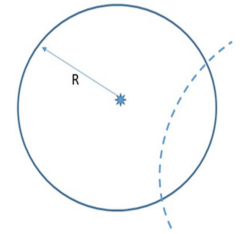


14 regions with 6 options each

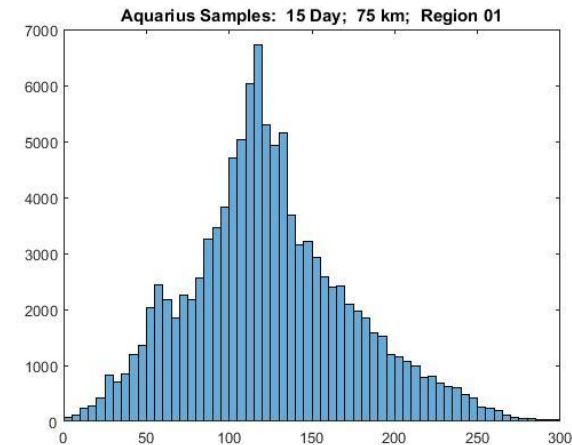
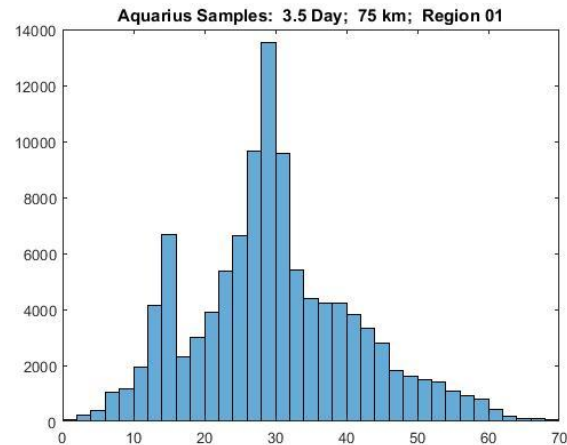
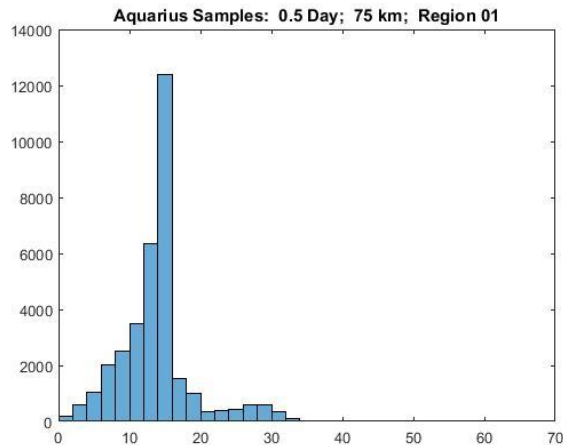
	+/- 0.5 day 25 km	+/- 0.5 day 75 km	+/- 3.5 day 25 km	+/- 3.5 day 75 km	+/- 15 days 25 km	+/- 15 days 75 km
1	1.3MB	3.9MB	8.3MB	20.1MB	10.1MB	22.1MB
2	2.7MB	7.8MB	16.9MB	41.3MB	20.4MB	45.1MB
3	1.1MB	3.1MB	6.5MB	15.7MB	7.9MB	17.3MB
4	71.6KB	274.5KB	430.8KB	1.4MB	597.1KB	1.6MB
5	NA	NA	NA	NA	NA	NA
6	NA	NA	231B	233B	418B	544B
7	885B	2.2KB	5.0KB	14.0KB	6.6KB	17.1KB
8	NA	NA	NA	NA	NA	NA
9	NA	NA	NA	NA	NA	NA
10	884 KB	2.6MB	5.2MB	11.5MB	6.3MB	12.9MB
11	192KB	574.5KB	950.1KB	1.9MB	1.1MB	2.0MB
12	16.6KB	55.6KB	92.5KB	317.3KB	122.4KB	362.0KB
13	NA	NA	NA	NA	NA	NA
14	74.6KB	226.4KB	461.2KB	1.1MB	609.9KB	1.3MB

# Effect of Time-Space Window

## Frequency of Occurrence



25 km



75 km

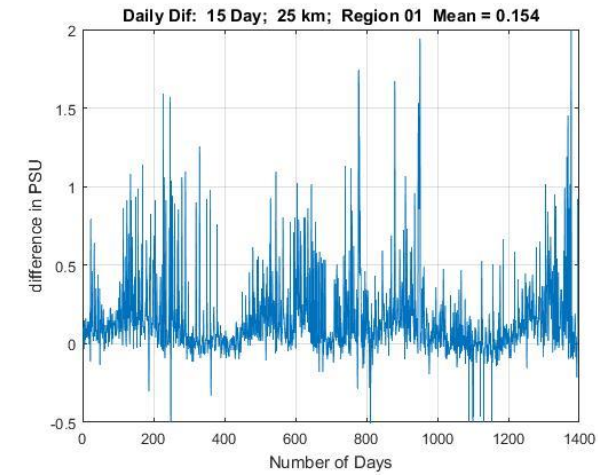
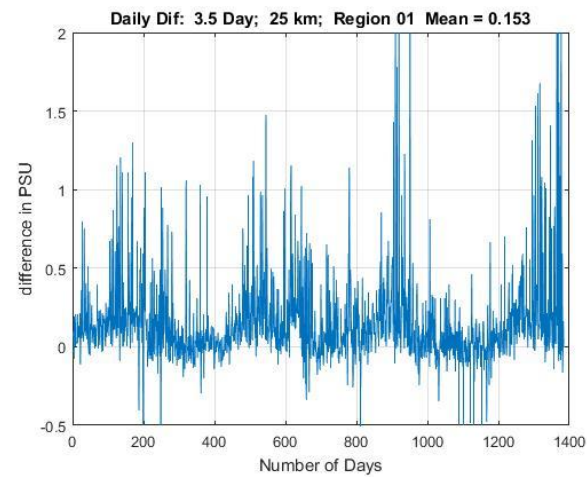
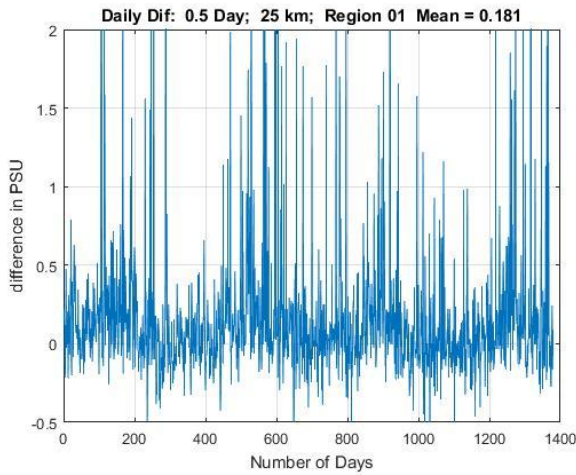
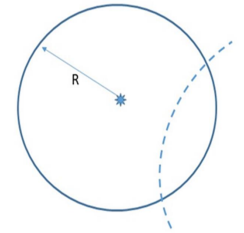
0.5 Days

3.5 Days

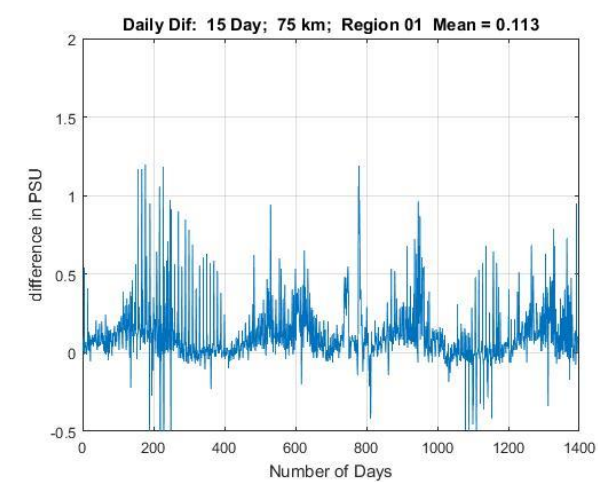
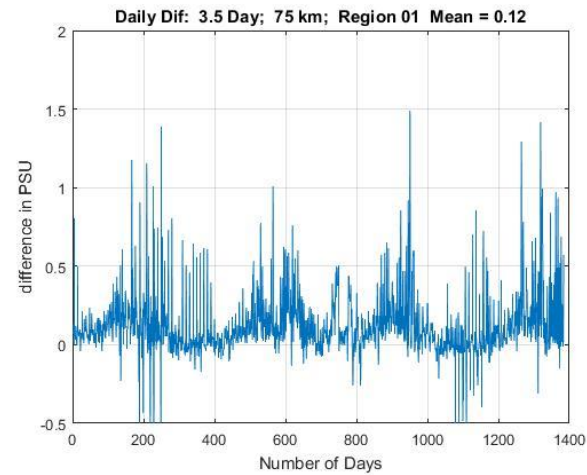
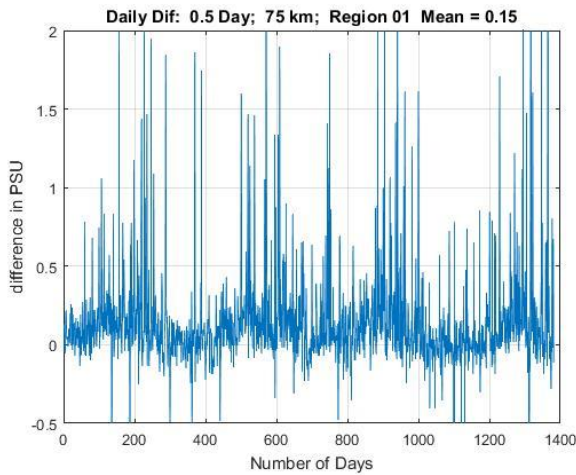
15 Days

# Effect of Space-Time Box

## Salinity Difference



25 km



75 km

0.5 Days

3.5 Days

15 Days



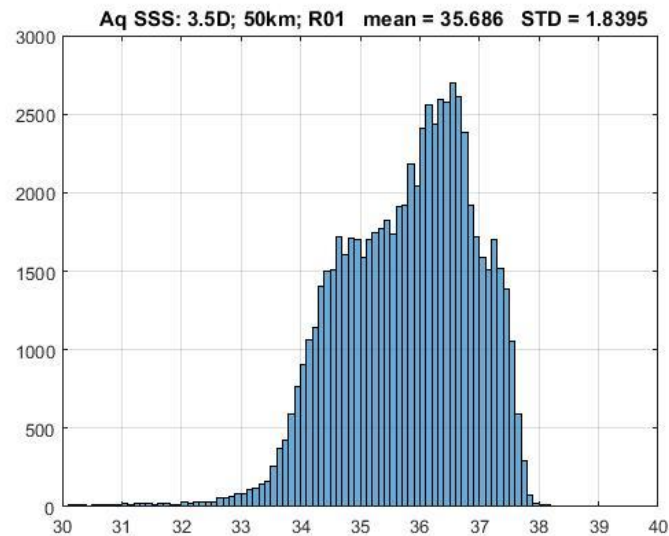
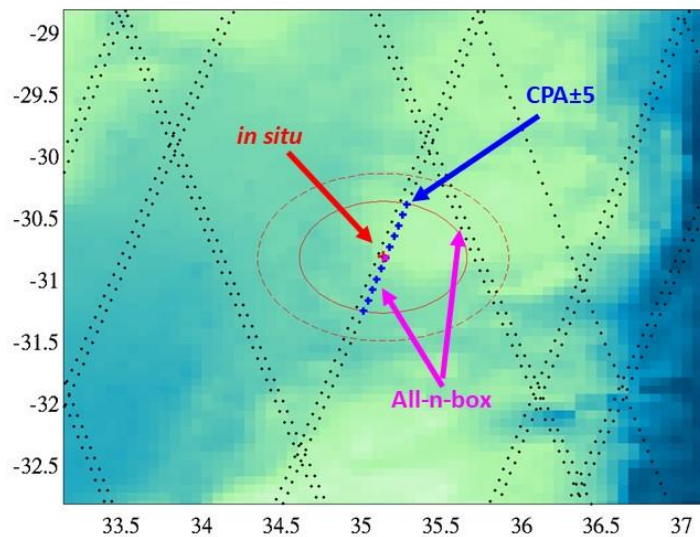
# Preliminary Conclusion

- Increase space (R) and/or time (T)
  - More samples
  - Less noise
- Optimum Choice: ??
  - $R = 75 \text{ km}$ ;  $T = \pm 3.5 \text{ days}$
  - Little improvement for larger values of R or T

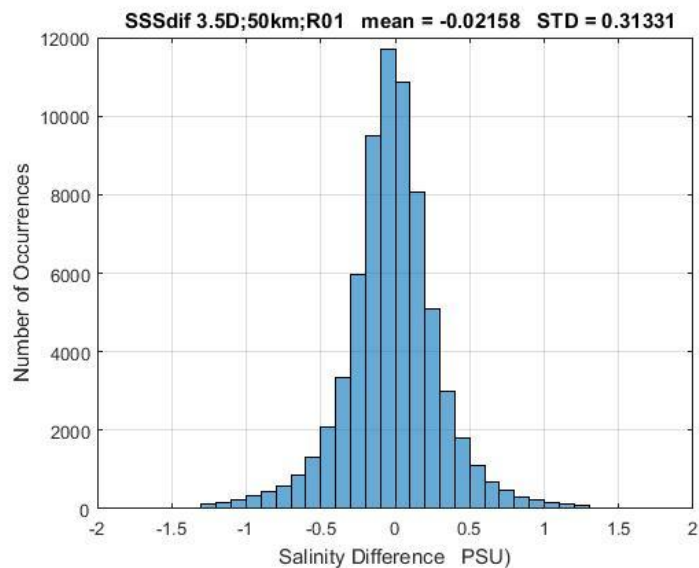
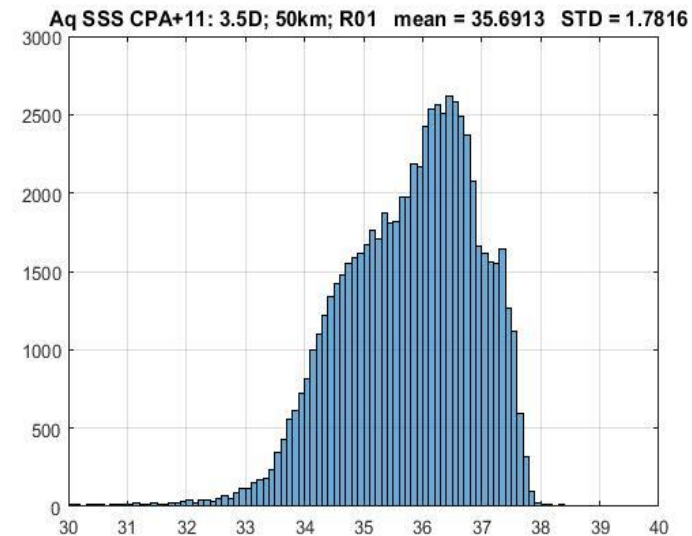
Next: Sampling Options, All-in-box vs CPA  $\pm 5$

# Sampling Options

R = 50 km; T =  $\pm 3.5$  day;  
Atlantic Ocean

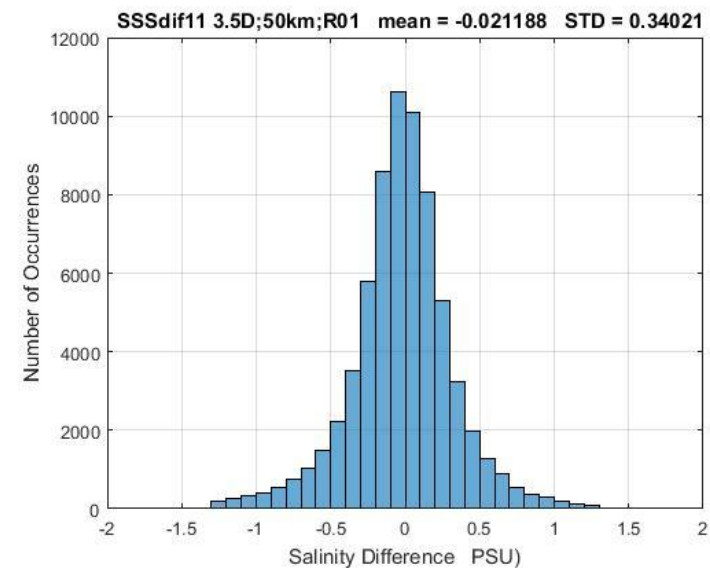


Salinity



All-in-Box

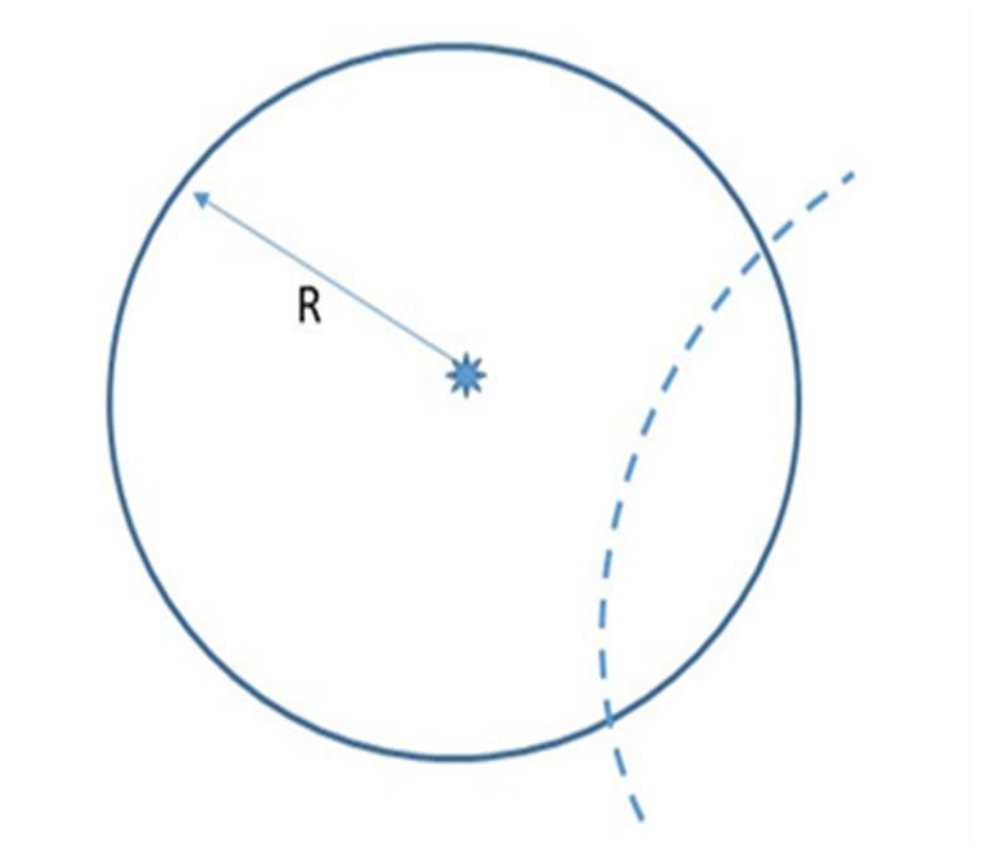
$\Delta$ SSS



CPA ± 5

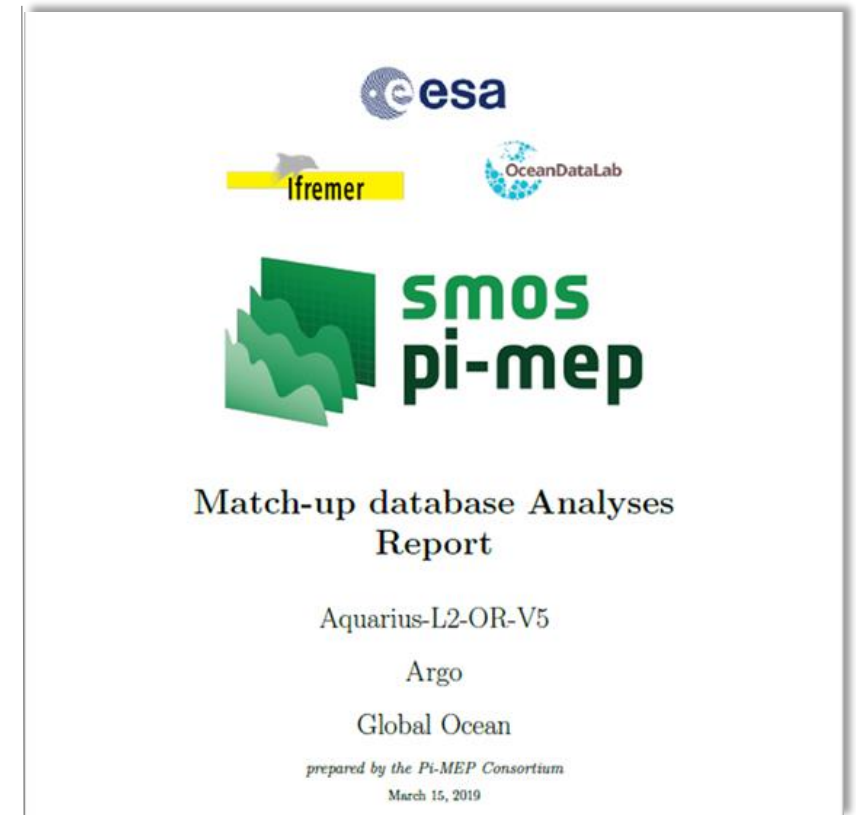
# Summary: Match Up Data Base

- Options
  - Time-Space Box
    - $T = \pm 3.5$  days,  $R = 75$  km
    - Reasonable choice
  - CPA $\pm 5$  vs All-in-Box
    - Close
    - All-in-box potentially better
      - Consistent with time-space window
- SMAP: TBD
  - All-in-box ?
    - SMAP noisier than Aquarius
    - All-in-box yields more samples
  - Time-Space
    - Consistency with Aquarius ?
      - $T = \pm 3.5$  days;  $R = 75$  km
    - Tune R to actual resolution?
- Need clear, detailed documentation
  - Flags used (land/ice fraction; other outliers)
  - Argo data and quality flags
    - Repeat times
    - Changes over time
  - Computational methodology
    - Implementation of time window



# Proposal for PI-MEP

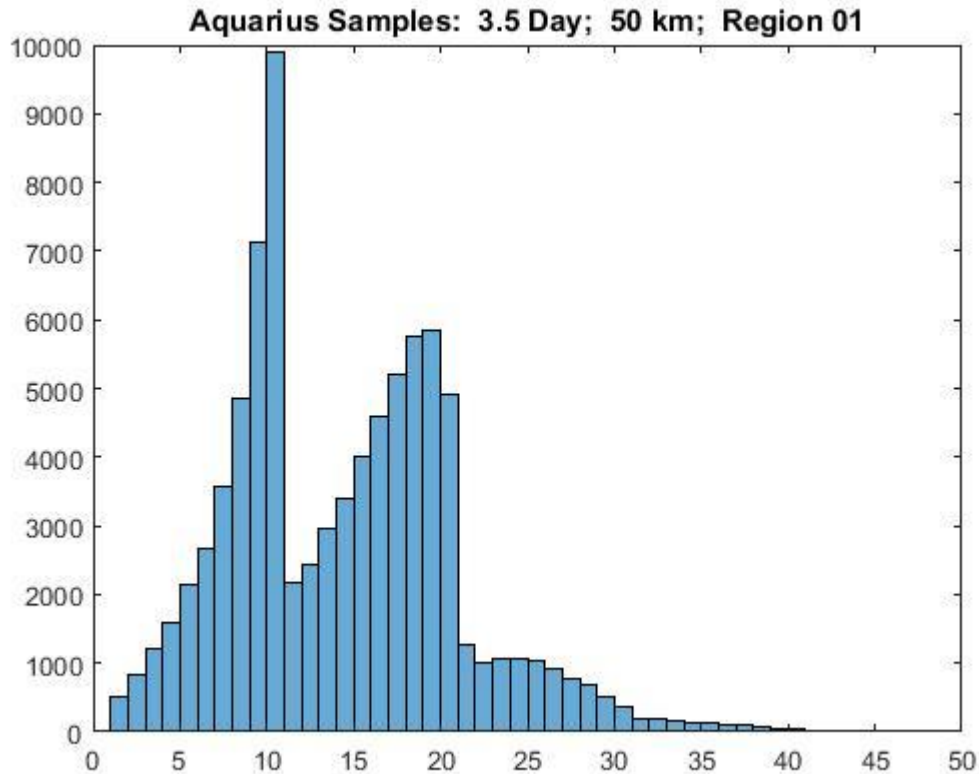
- Add Information on Aquarius/SMAP
  - Links to SCP products
    - Match up data base (e.g. AVDS & SVDS)
    - SMAP/Aquarius evaluation reports
  - Produce “reports” for SMAP and Aquarius
    - PI-MEP format
    - Using SCP data
  - Provide Aquarius/SMAP match up data
    - Within PI-MEP if desired
    - Otherwise links to SCP products
- Assist with Documentation
  - Description of Aquarius/SMAP
  - Details of match up data base and options



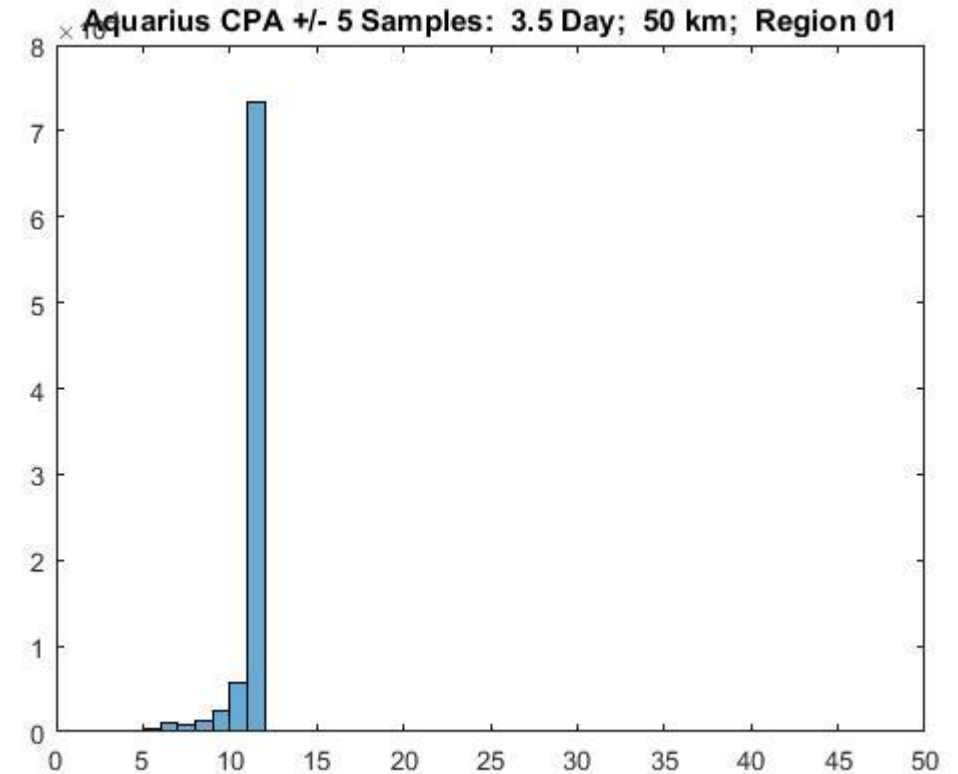
The END

# Sampling Options: CPA $\pm 5$ vs All-in-box

R = 50 km; T =  $\pm 3.5$  day; Atlantic Ocean



All samples in time-space window



CPA  $\pm 5$