Salinity from space
(Spatial-temporal variability)

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ESA

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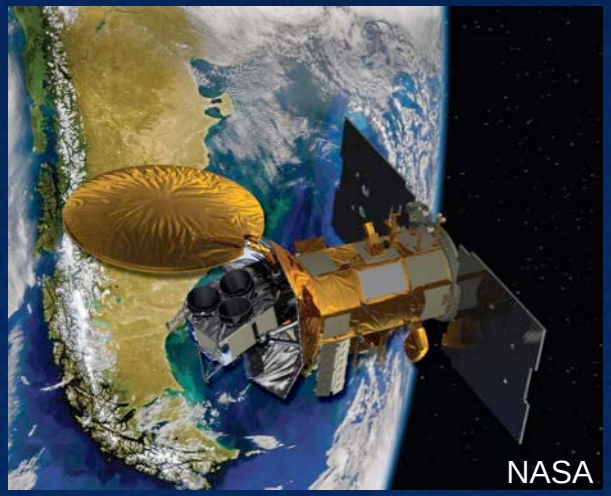
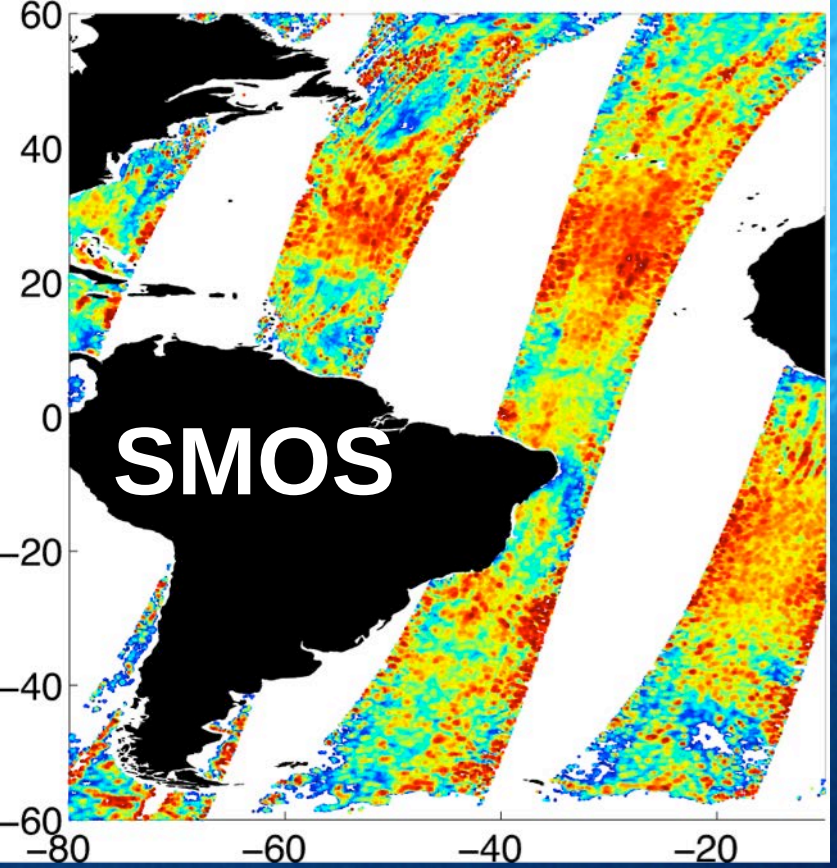
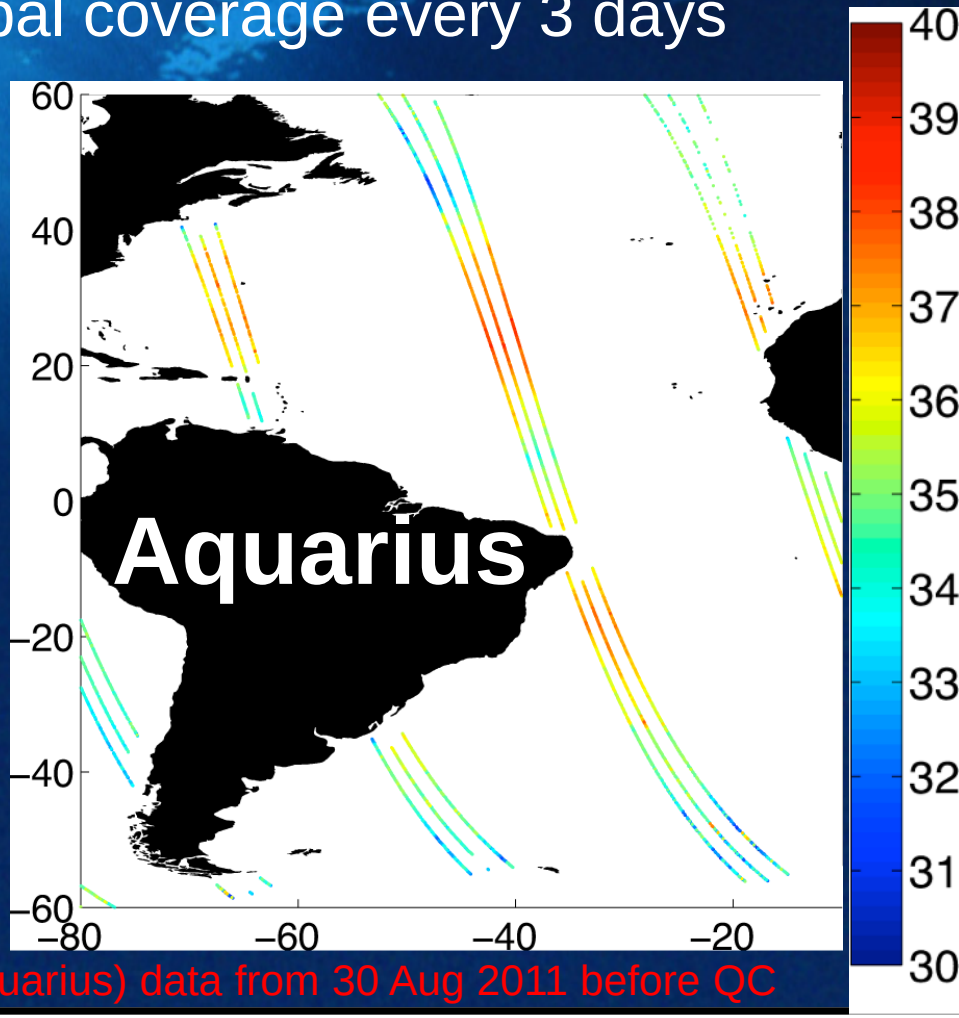

NASA



Innovative passive interferometry
Swath width ~500-700 km
Resolution: ~35-50 km
Global coverage every 3 days



3 narrow beams
Resolution: ~100-150 km
Global coverage every 7 days

All descending (SMOS) or ascending (Aquarius) data from 30 Aug 2011 before QC

Contents

- Brief review of previous studies – Level 3 cal/val with Argo and Met Office FOAM/NEMO
- Spatial-temporal variability
- Ongoing studies

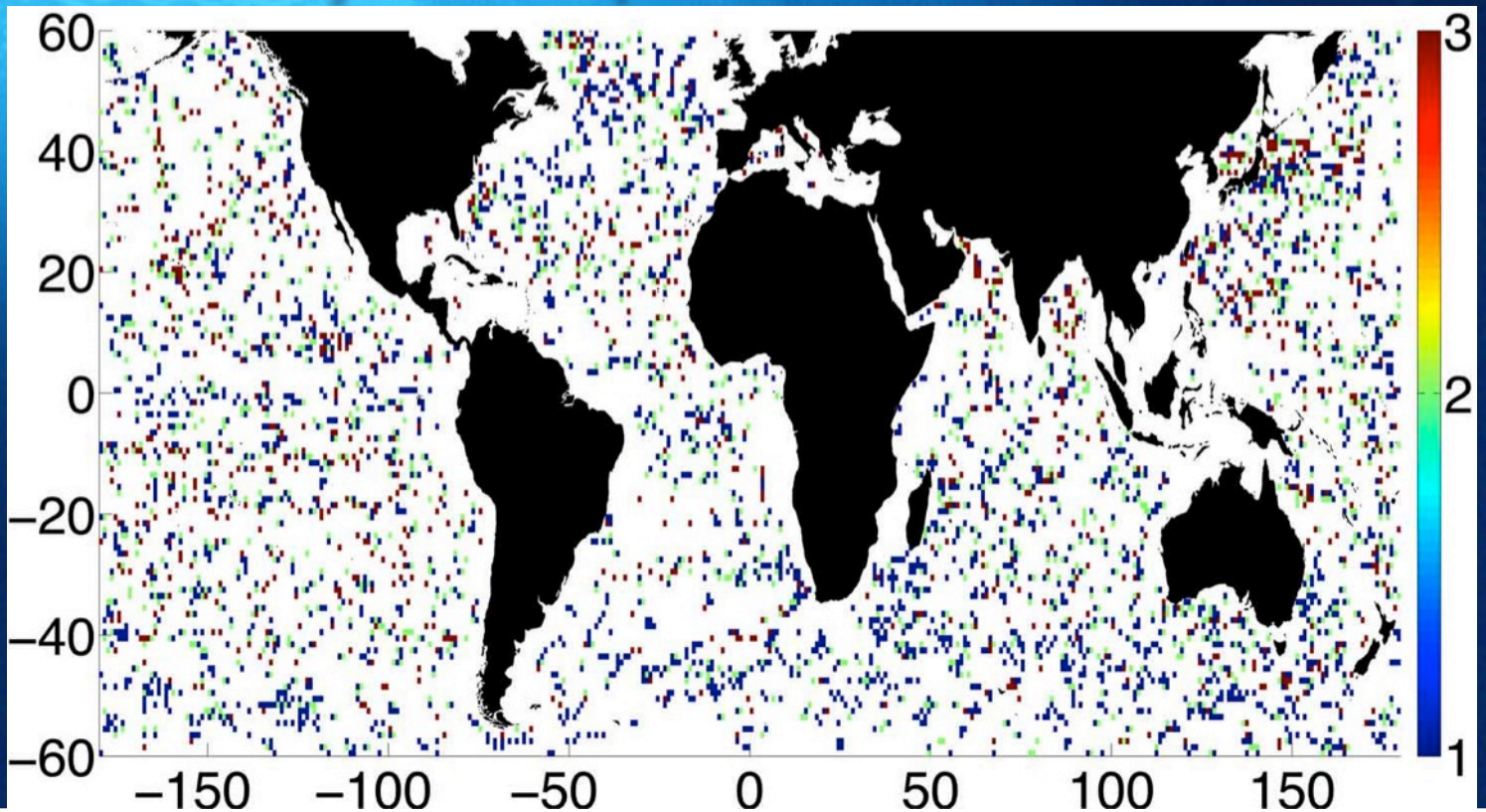
The aim is for assimilation studies of satellite salinity into Met Office models

Validation Data I – Argo

- Coriolis data centre
- Any profile with one valid measurement of salinity at depth <10 m
- Median salinity of each profile
- Median of 1º grid cells by month
- All near real time QC

Why do we need model/satellite data?

- Shallowest in situ salinity typically ~ 5-10 m
- >3000 floats worldwide, vertical profiles of salinity & temperature every 10 days



Number of Argo profiles in November 2011

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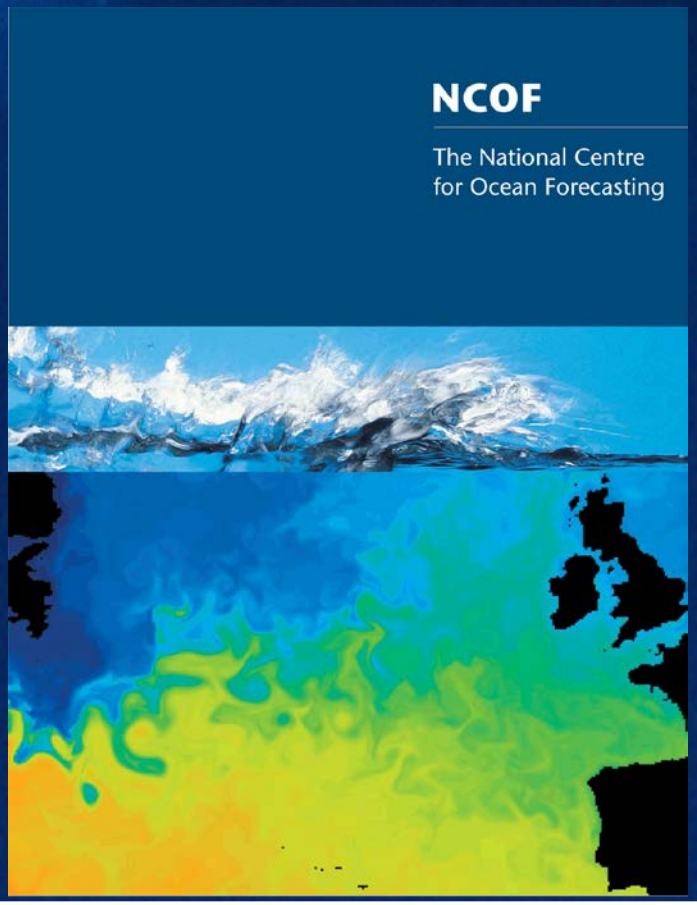
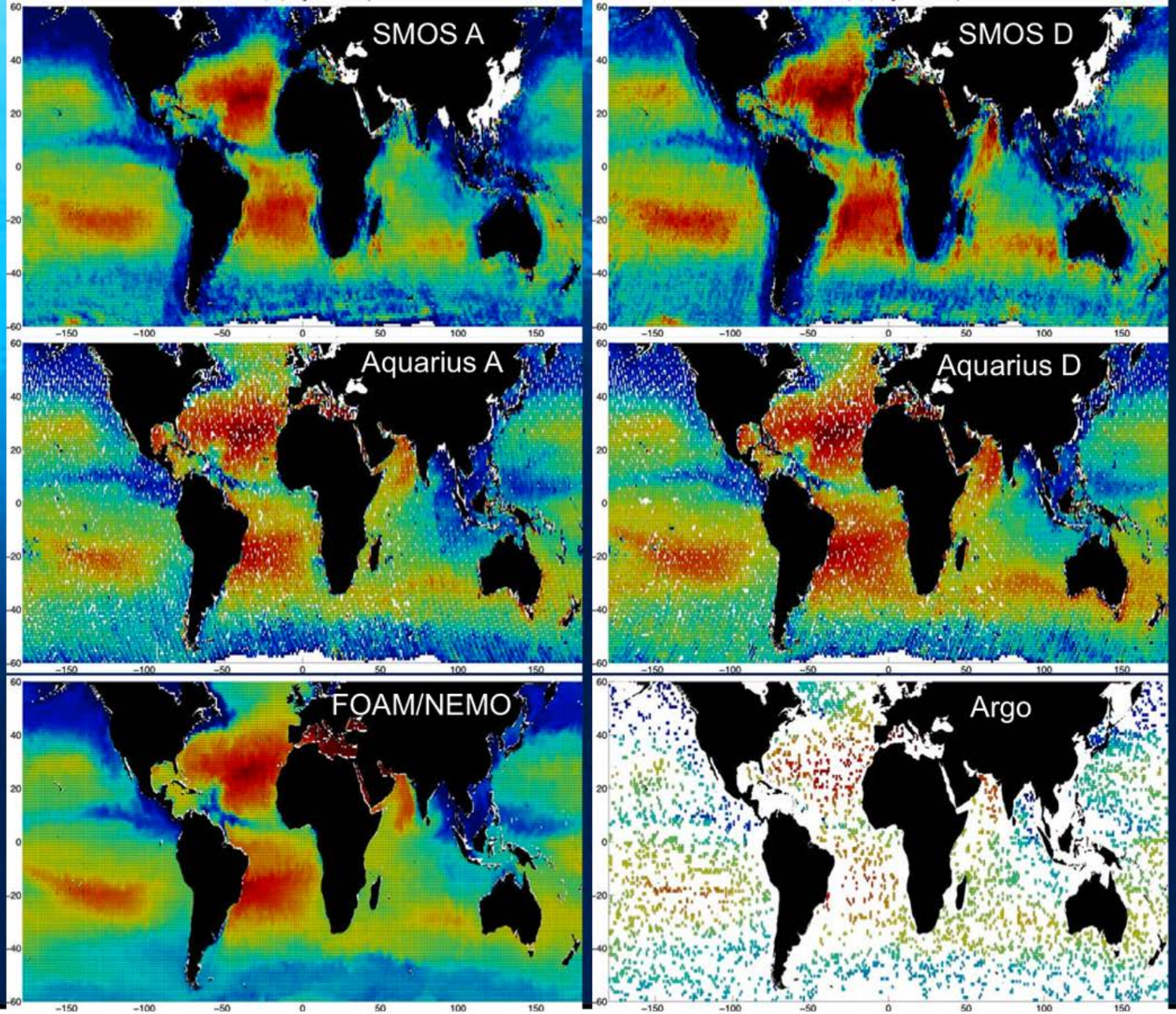
Validation Data II – FOAM/NEMO

Forecasting Ocean Assimilation Model based on Nucleus for European Modelling of the Ocean

- ¼º resolution daily
- Averaged (mean) to 1º and then monthly
- Assimilates **Argo** data, as well as satellite SST, SSH and sea ice data



September 2011



Monthly, 1ºx1º
SMOS:
Jan 2010-date
Aquarius:
Sept 2011-

32 38

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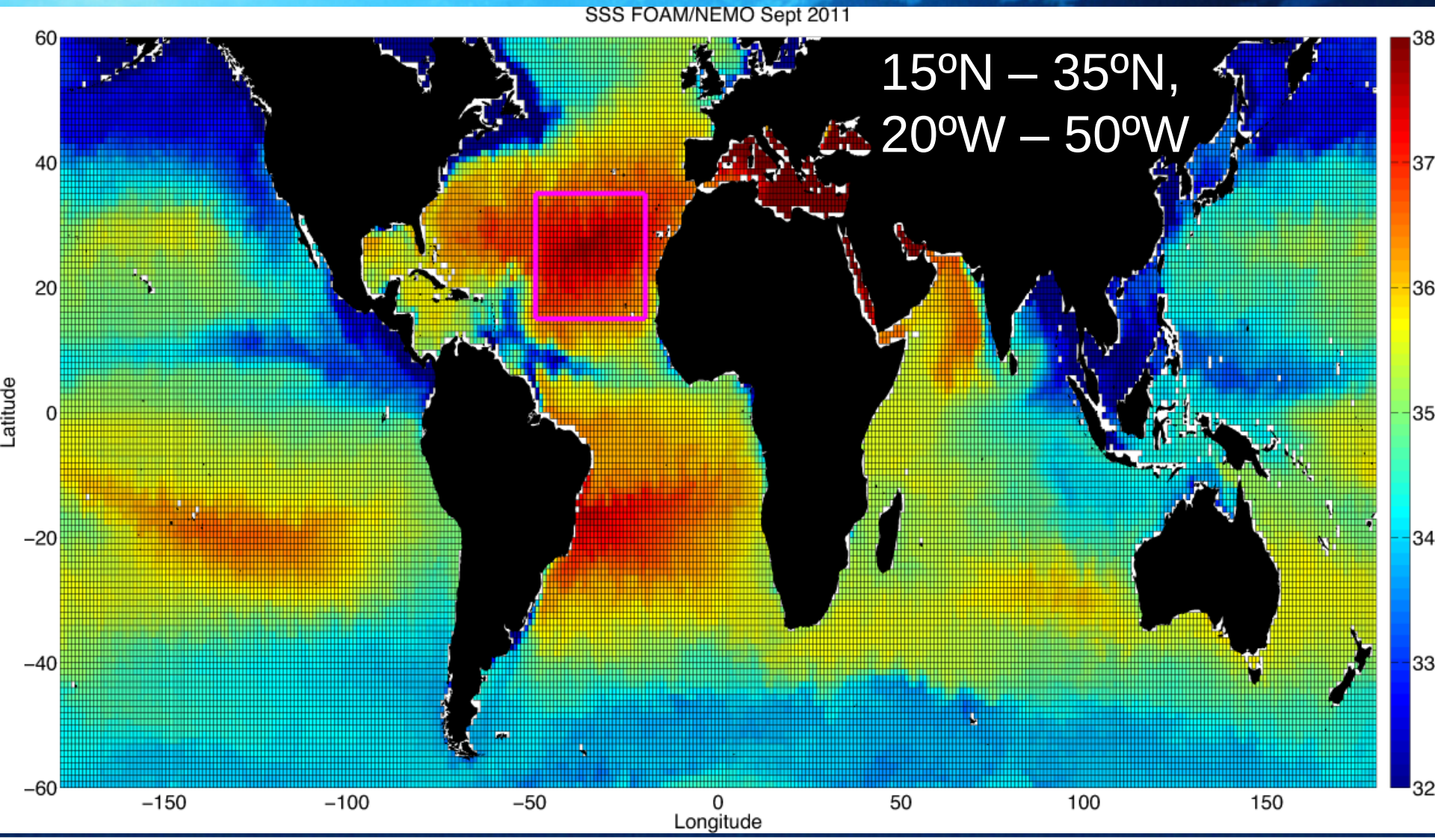
SPURS study region



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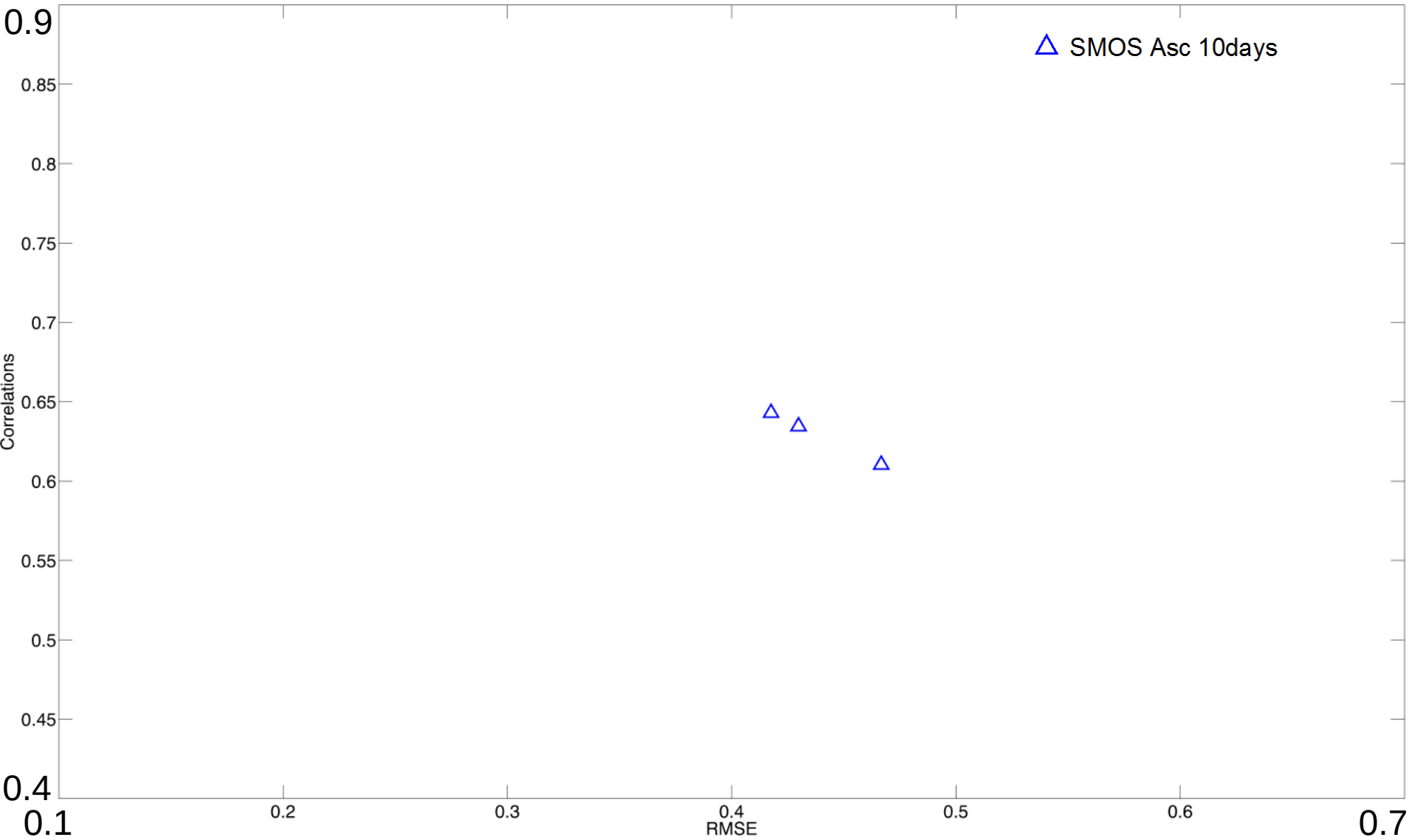
Time and space scales

- SMOS / Aquarius
- 10 days / monthly
- ¼º / ½º / 1º
- Asc / Desc / Asc & Desc
- Jan 2010 (Sept 2011) – Dec 2013
- Comparison with Argo at same space/time scale
  - As before
- (All products now reprocessed)

SPURS region



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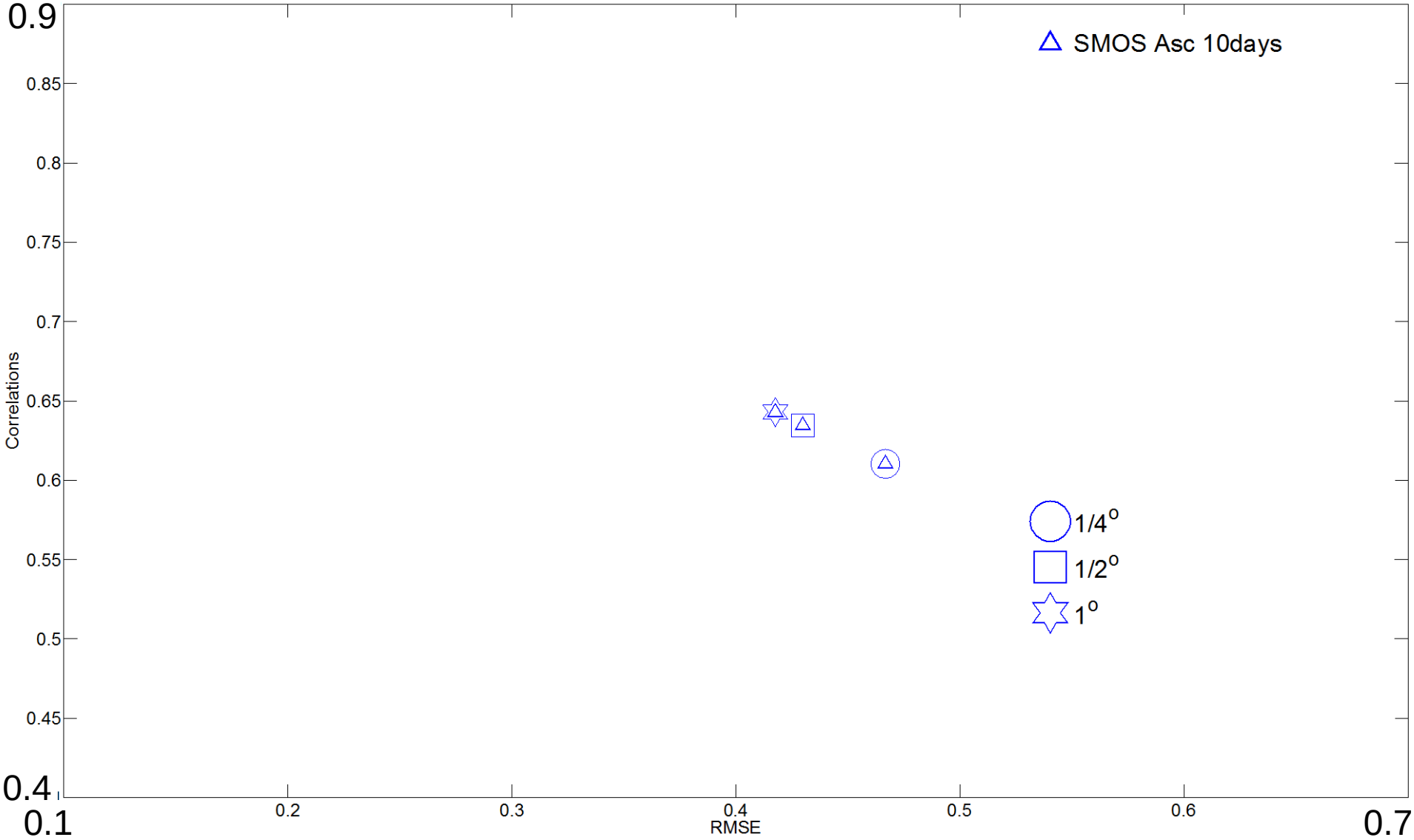

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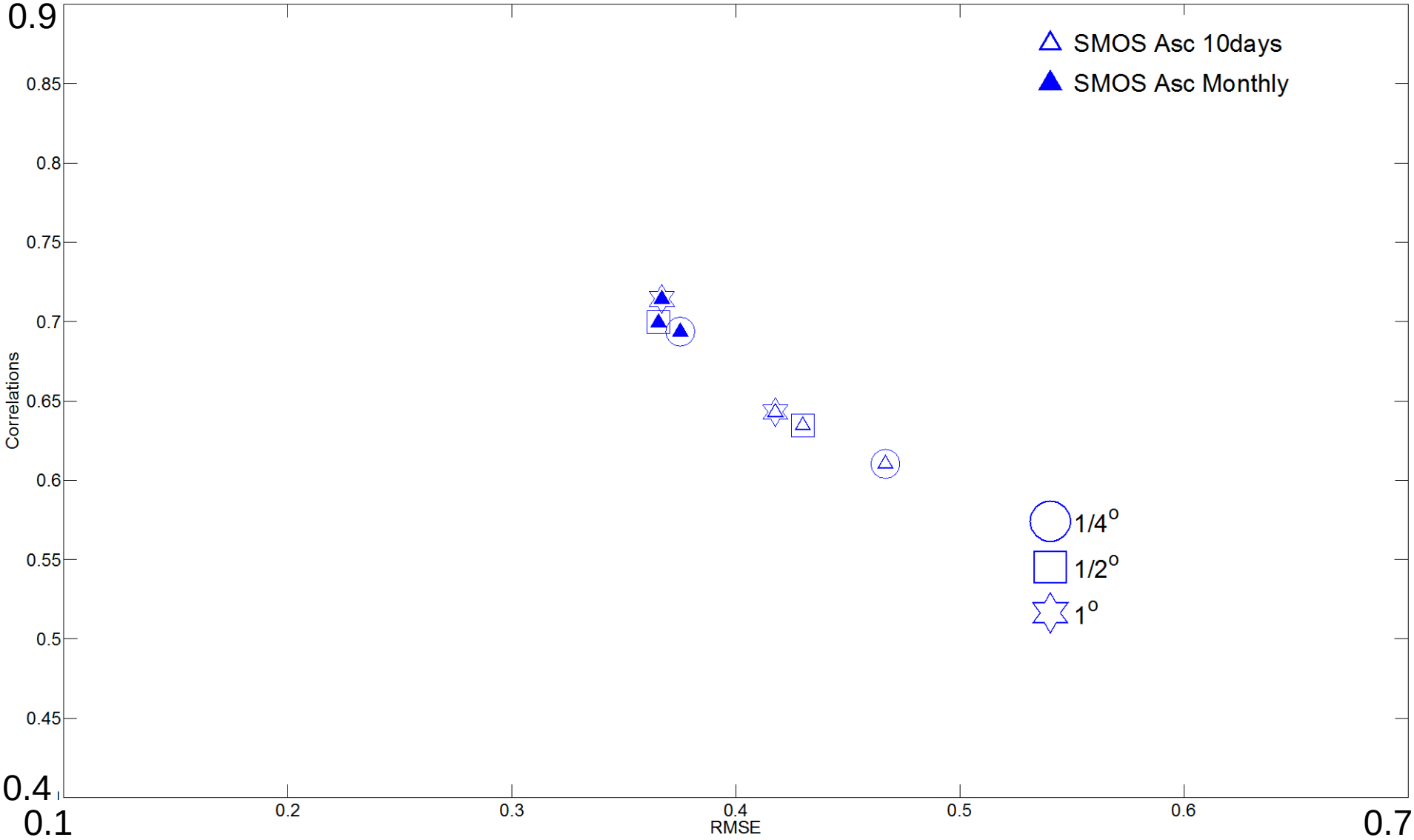

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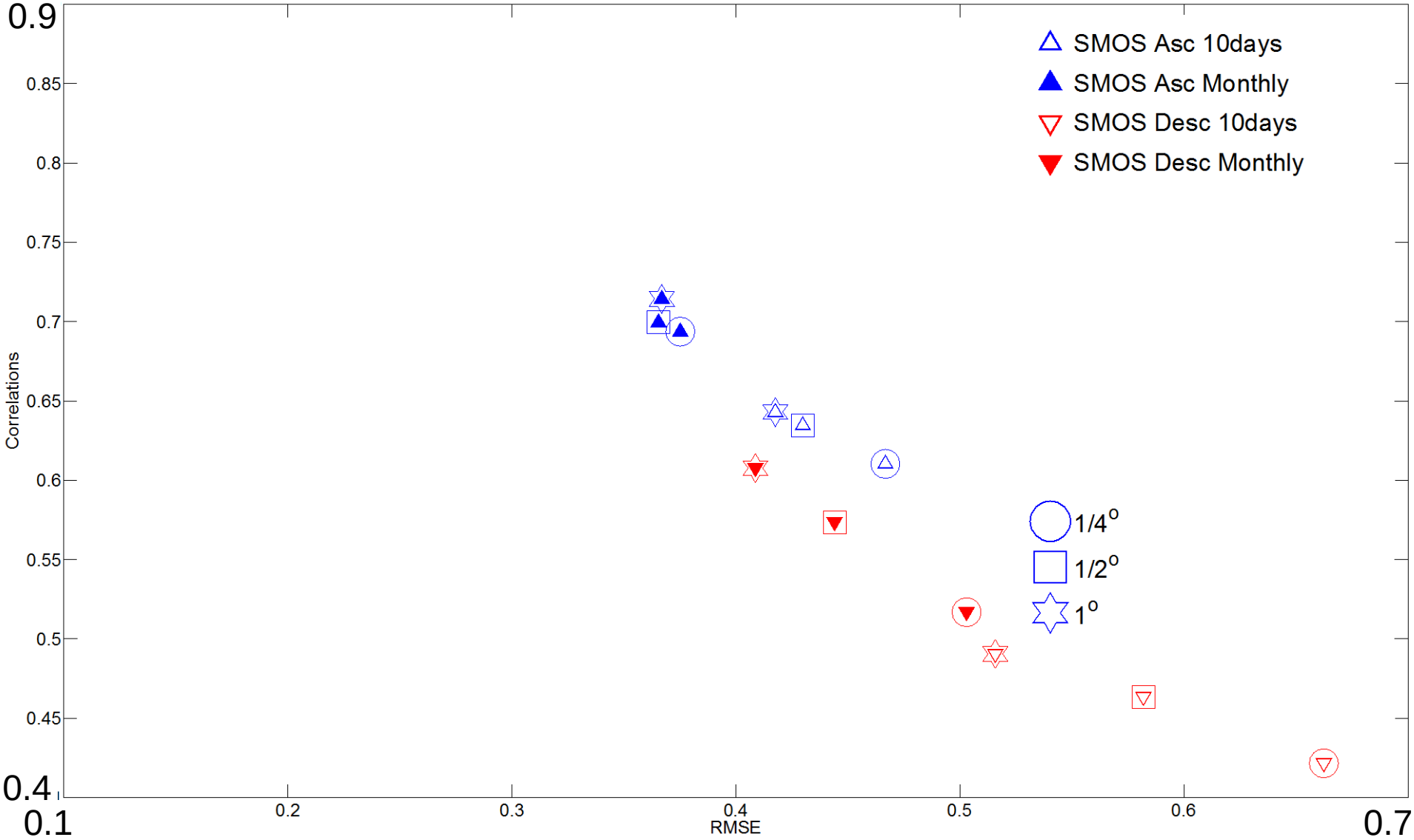

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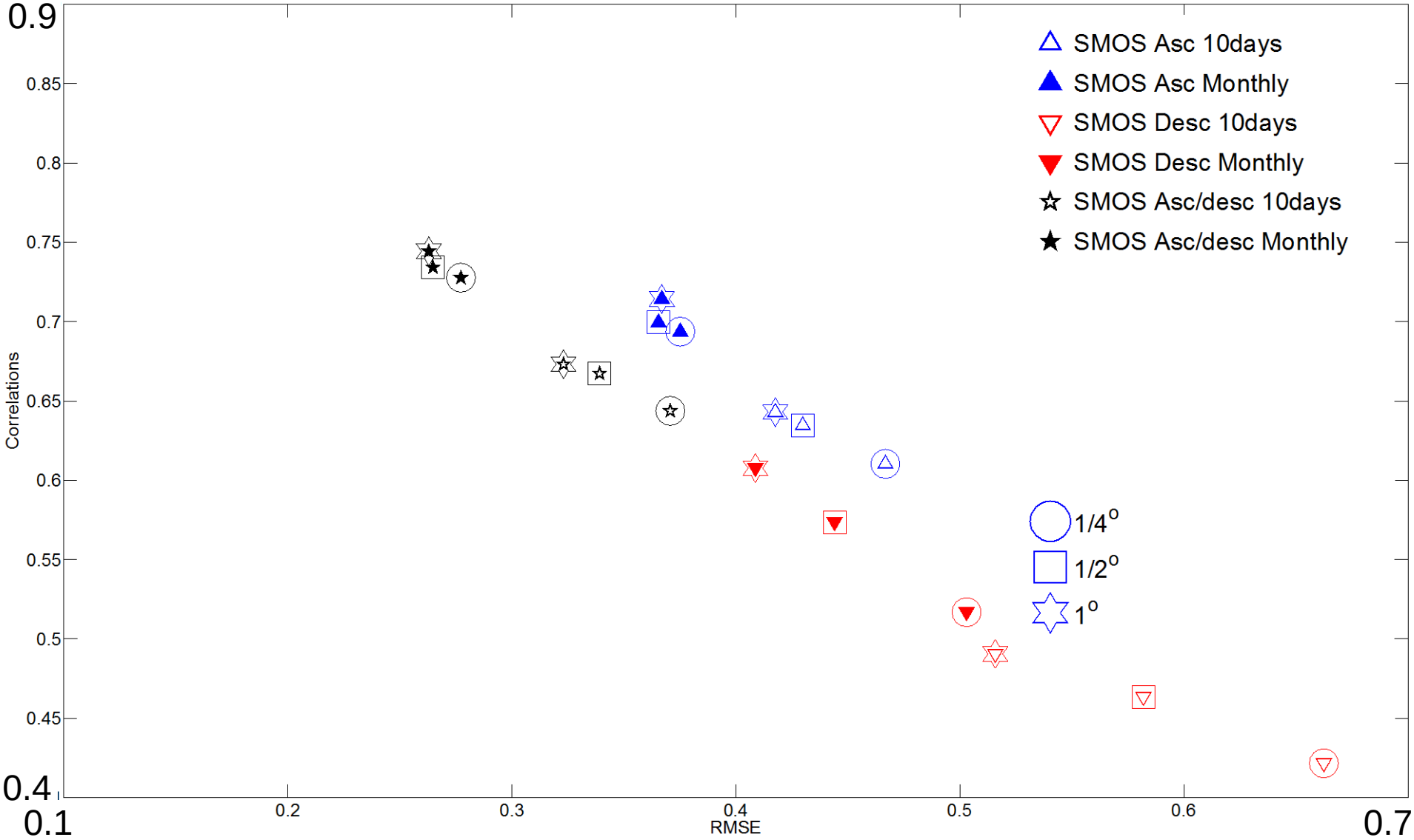

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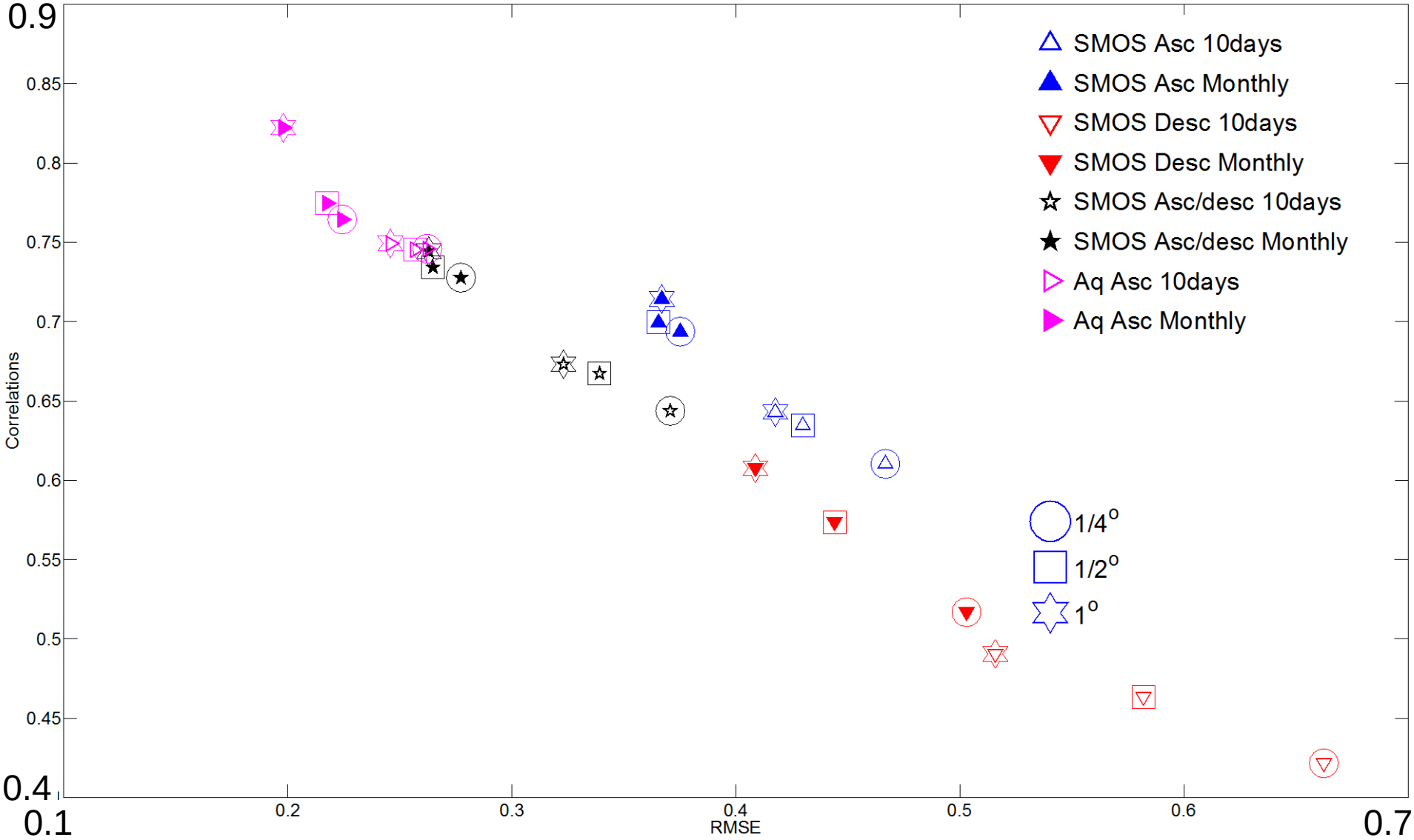

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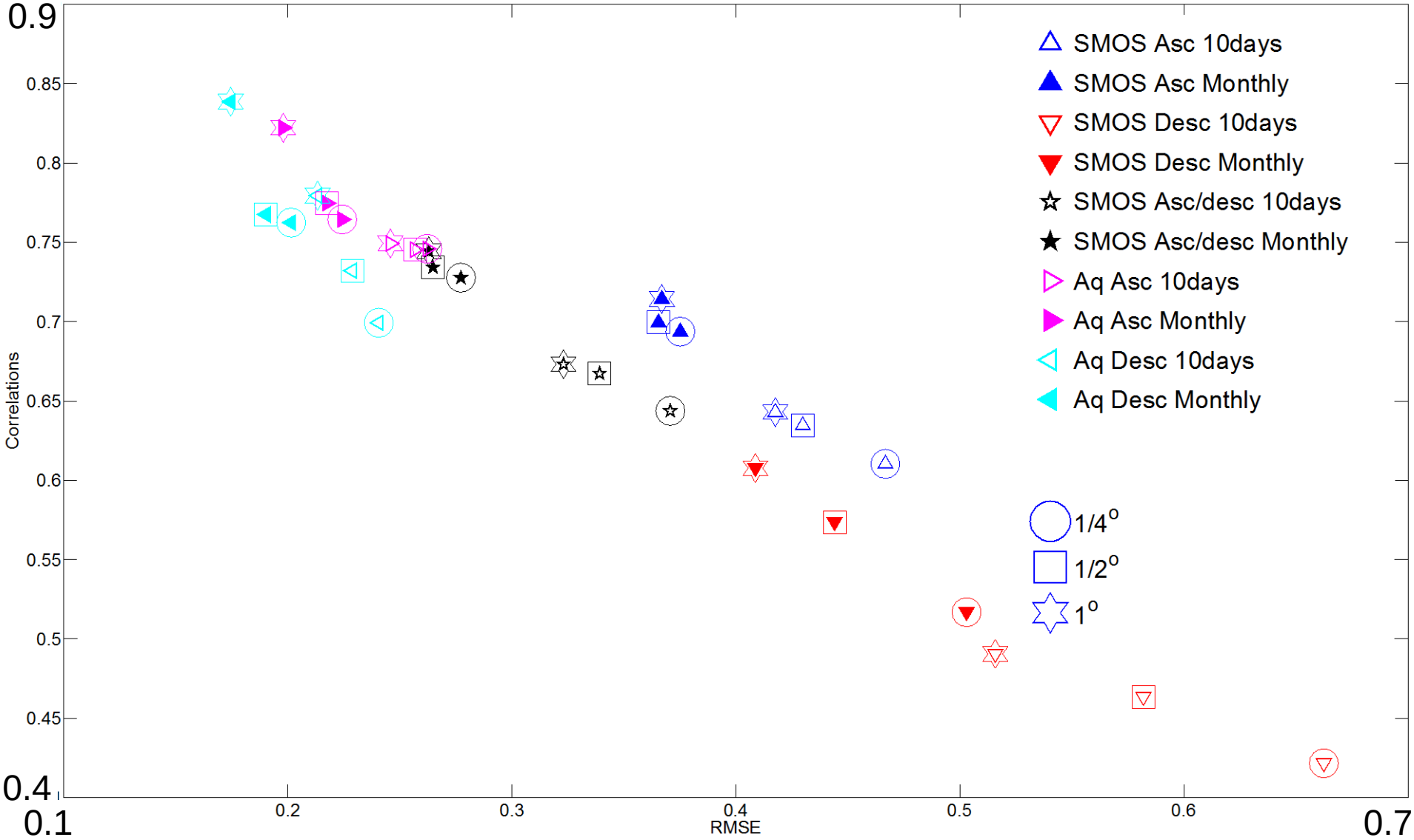

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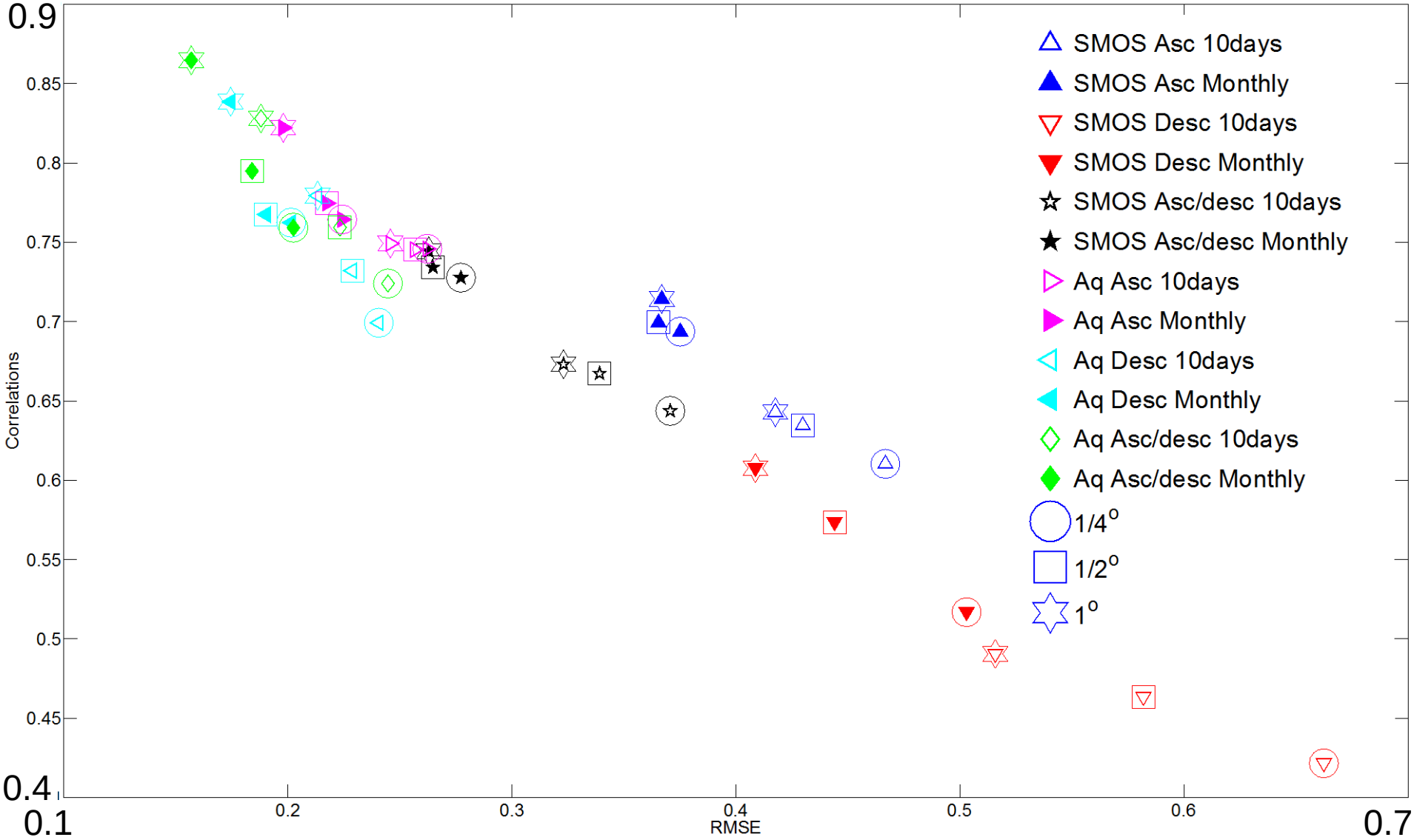
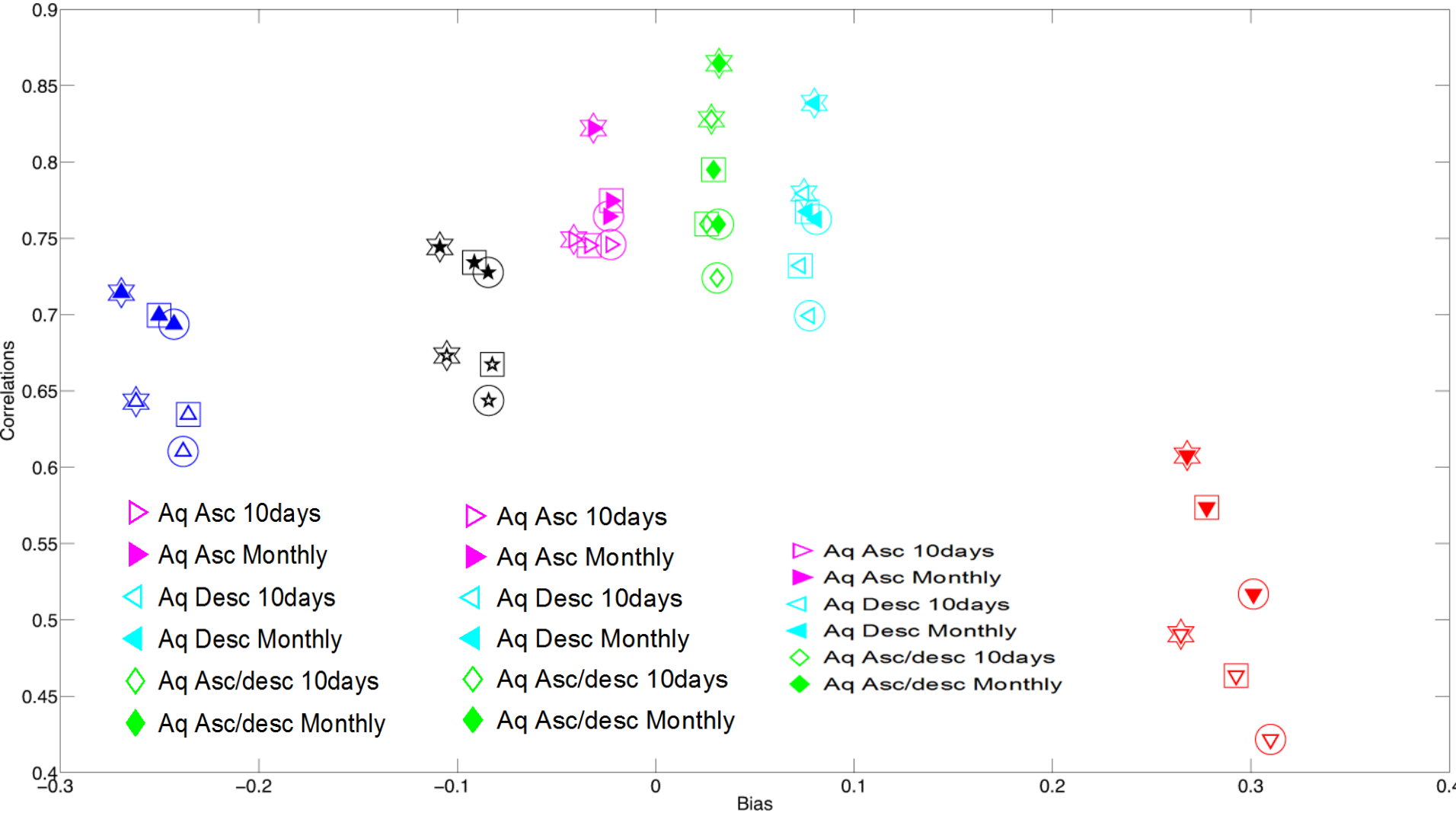


SPURS region



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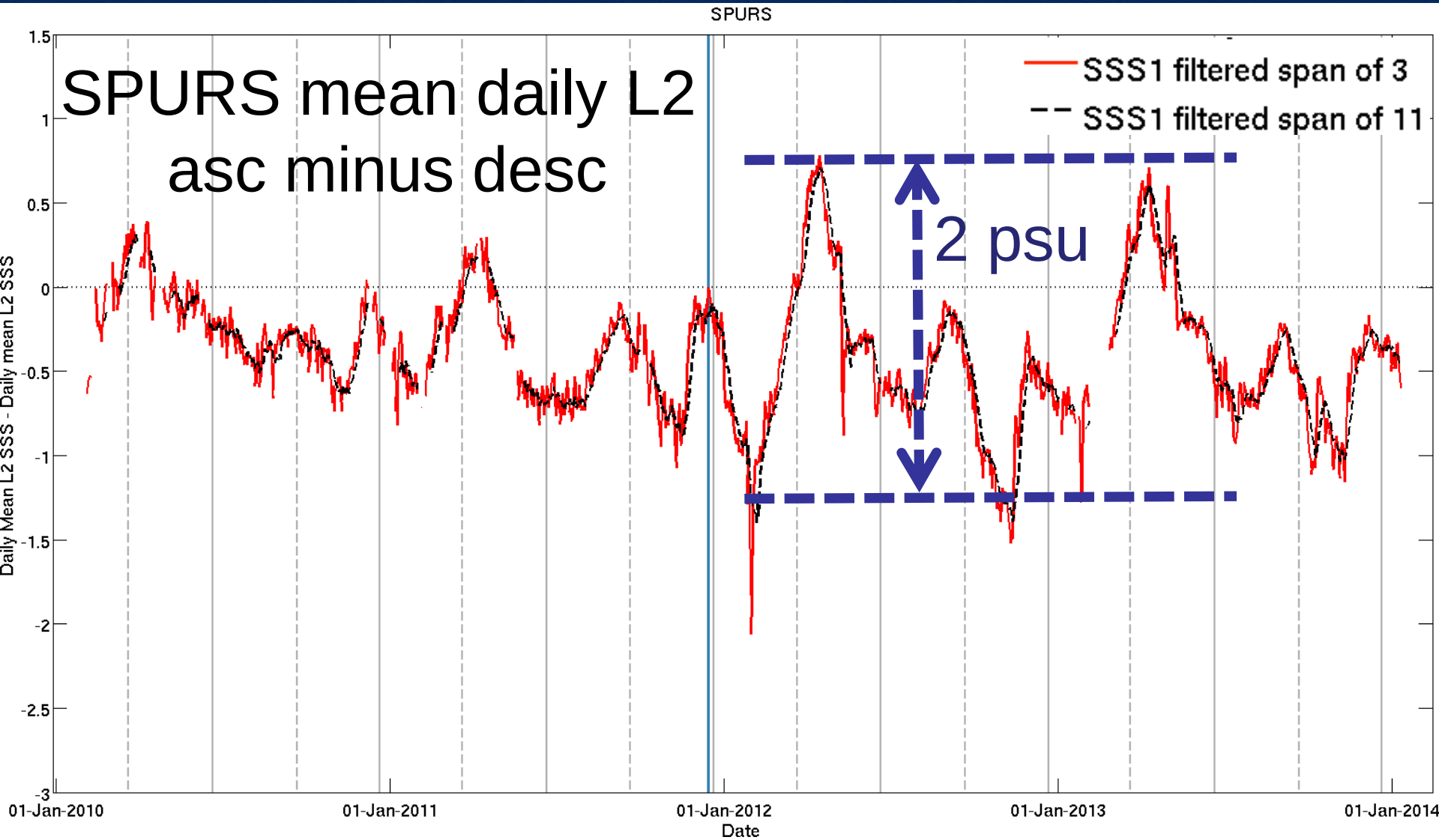
So combined ascending and descending is best?



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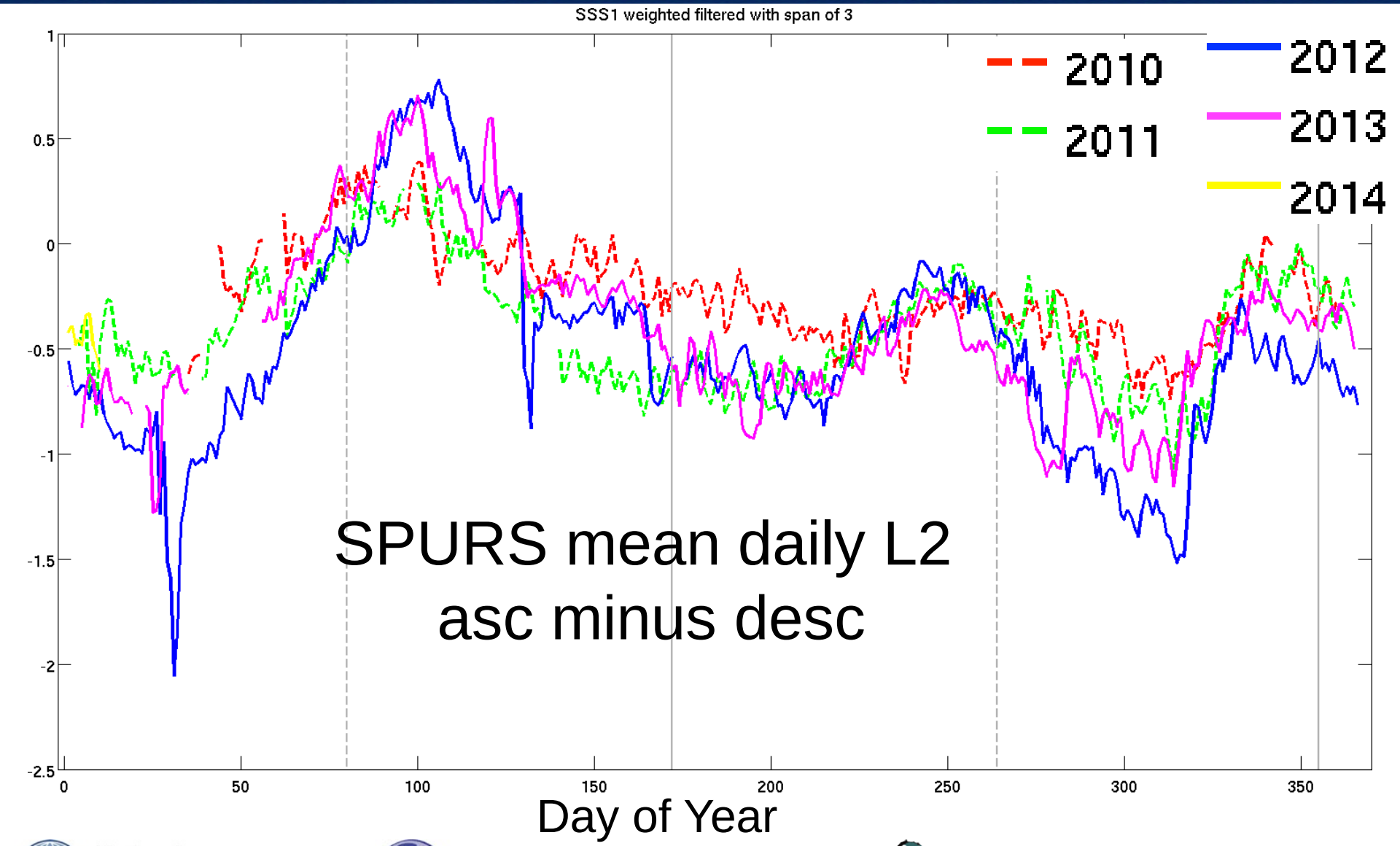

SPURS mean daily L2
asc minus desc

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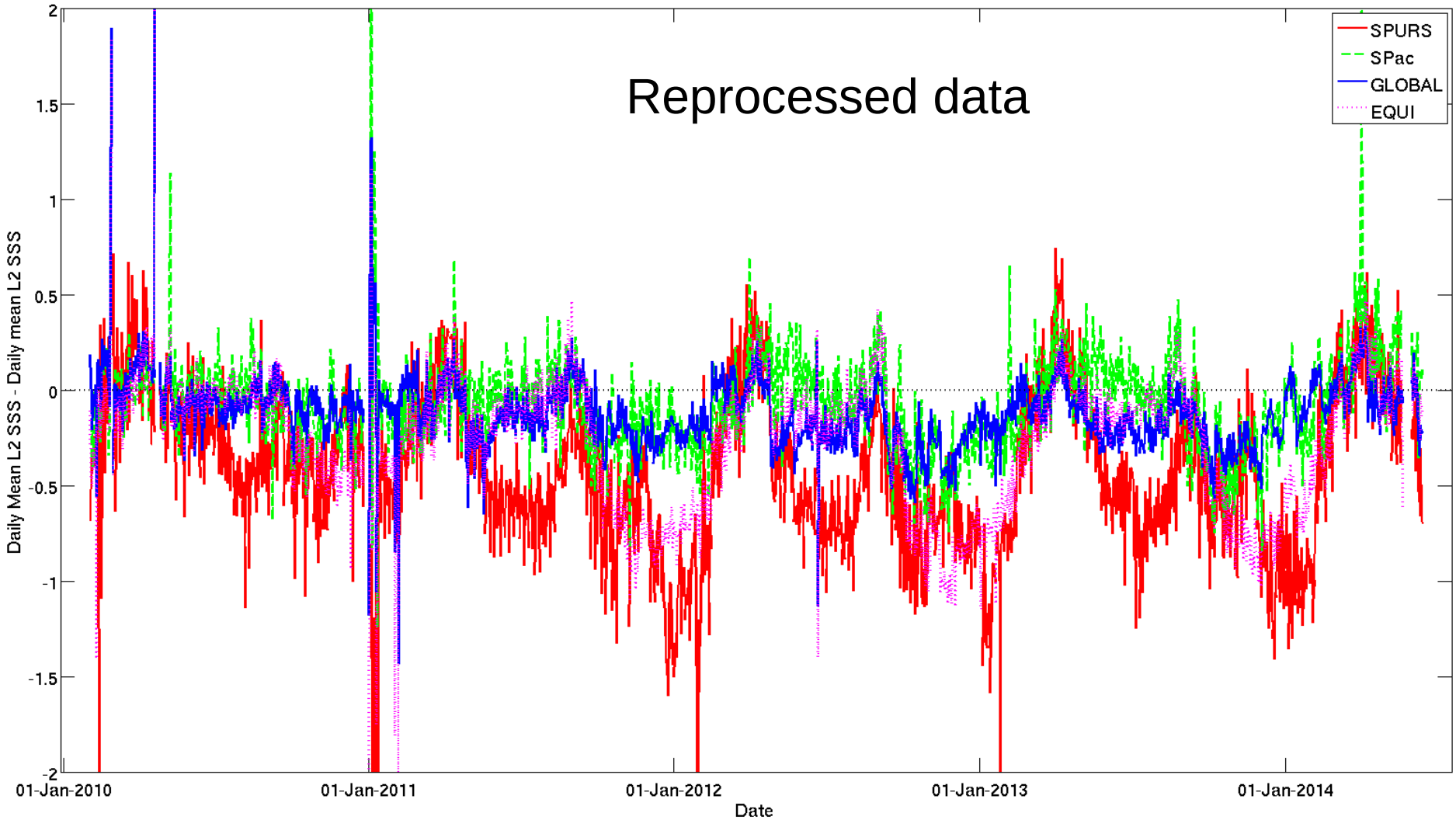
Is SPURS a suitable area?



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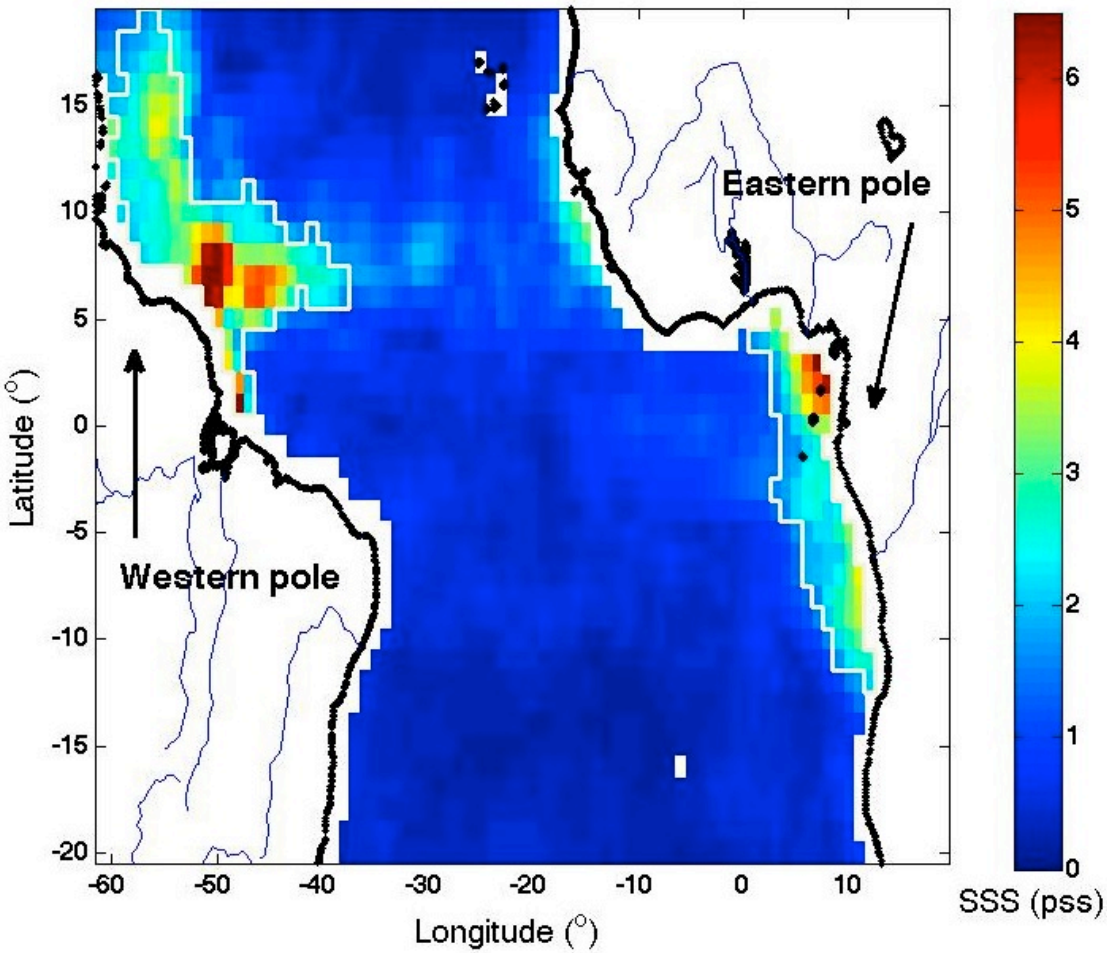
Tropical Atlantic Salinity Variability from SMOS

SSS range within a year

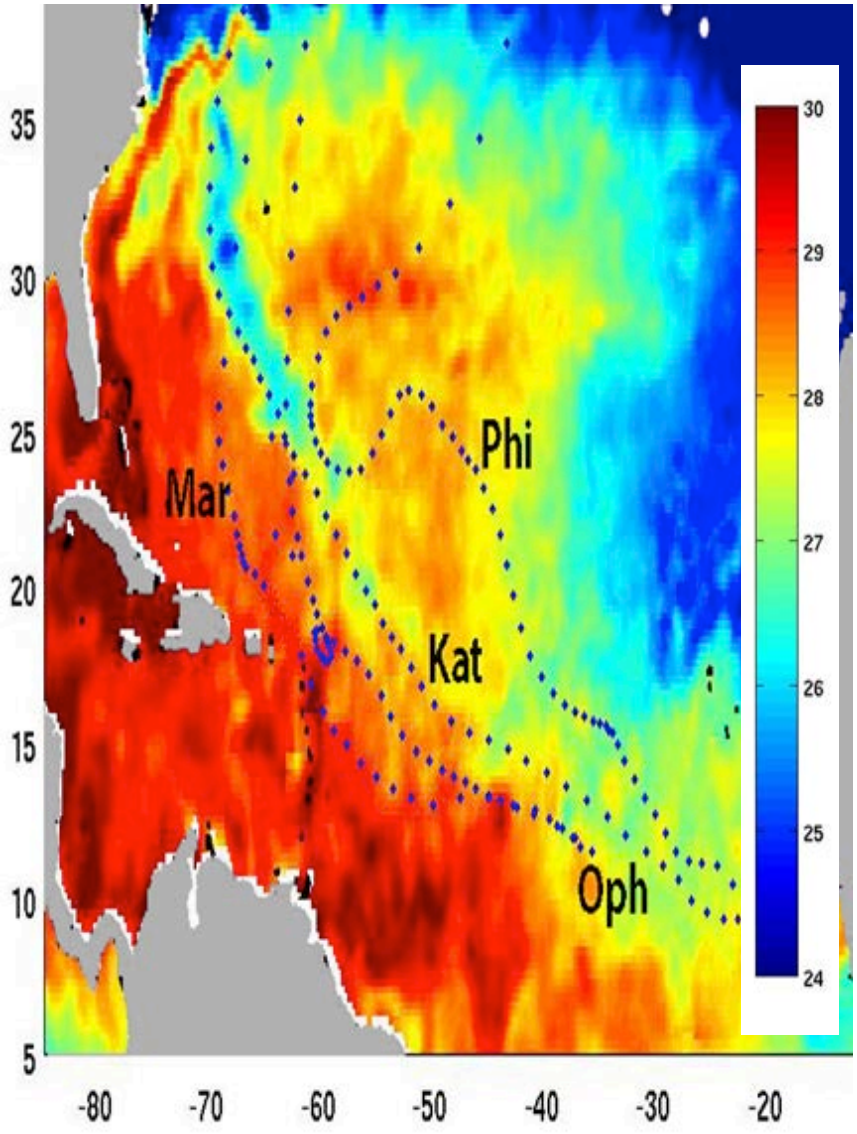


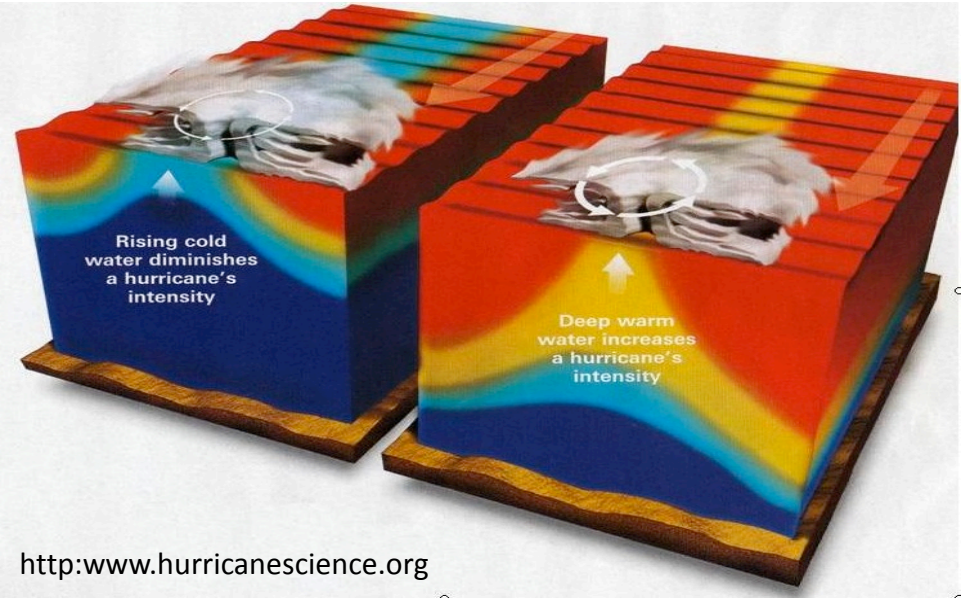
- two "poles" of strong seasonal SSS variability in W. & E. basin, N./S. of equator. (range > 1.5 for **all** years)
- Major rivers contribute to generation of poles
- Out-of-phase SSS seasonal cycles in poles compensate for little variation in whole region (not shown)

See paper by **Tzortzi *et al.*, 2013, Tropical Atlantic salinity variability: new insights from SMOS, GRL, v.40**

Tropical Cyclones, mixed layer and salinity

Impact of Tropical Cyclones (September 2011) on North Atlantic OSTIA SST



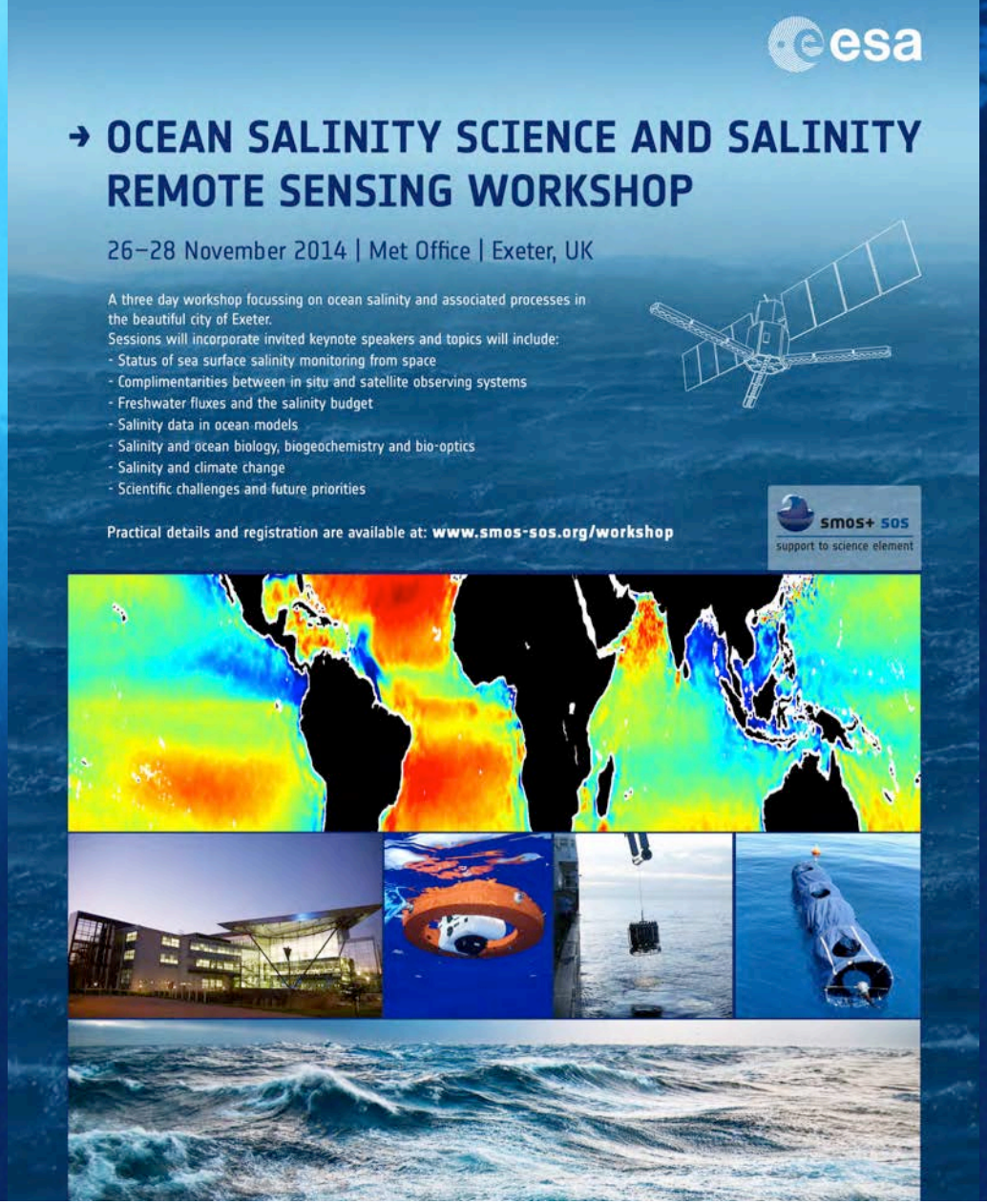


TC cyclones upwell cold water from below the thermocline to the surface

R. Catany (2011) MRes project

Conclusions

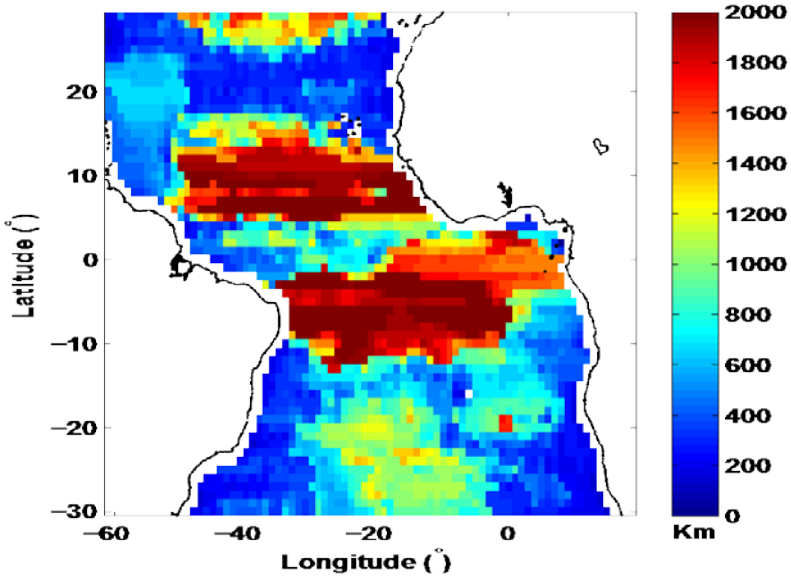
- SMOS and Aquarius show differences between SSS data for asc versus SSS for desc passes
  - problematic for assimilation into models
- SMOS calibration in S. Pacific – what would spatio-temporal results look like there?
- SMOS impacted by land contamination
- Temporal changes (10 days/month) tend to have greater impact than spatial (¼º/½º/1º)
- Potential for salinity from space in science studies is now being realised



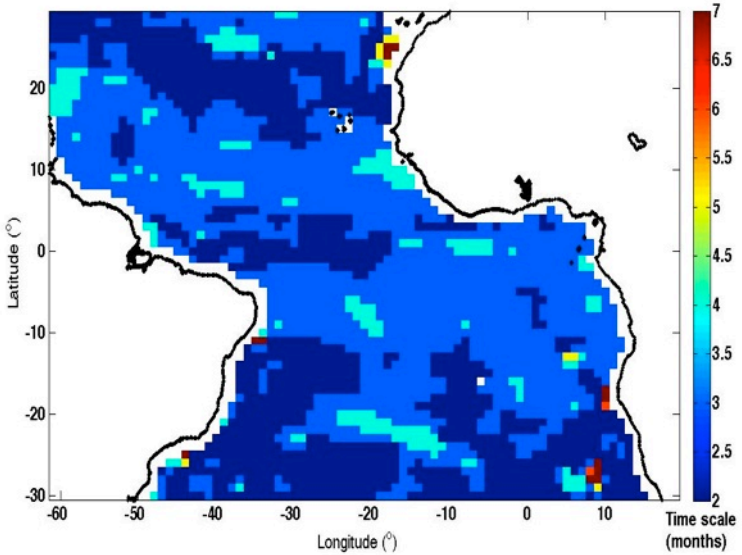
oceansalinityscience2014.org

Spatio-temporal Scales of SSS from SMOS

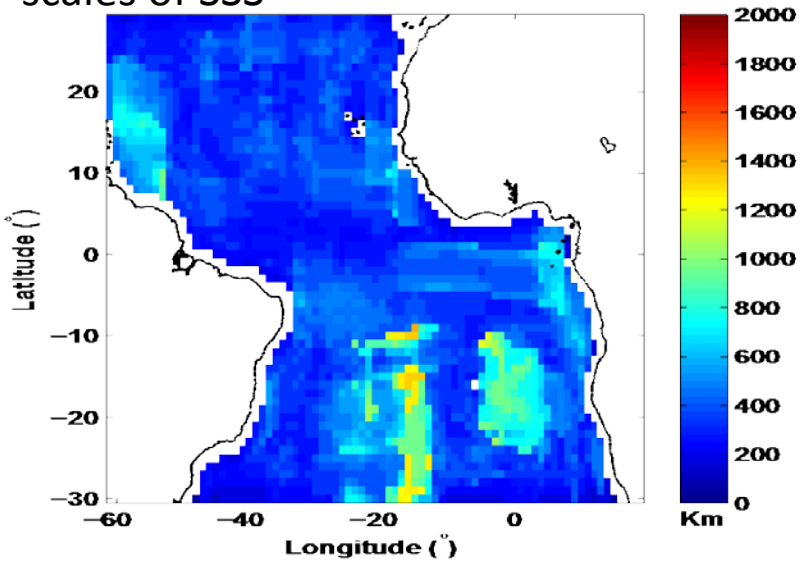
Mean zonal (W-E) spatial length scales of SSS



Temporal decorrelation scales of SSS



Mean meridional (N-S) spatial length scales of SSS



Anisotropic spatial scales of SSS in the Atlantic 30° N-30° S, i.e. zonal (W-E direction) length scales are larger than the meridional (N-S direction)

Homogenous SSS variations over large lengths that span across the whole basin width

SSS changes persist up to ~3.5 months over most of the basin