SMOS Brightness Temperature Measurements
- Performance and Evolution -

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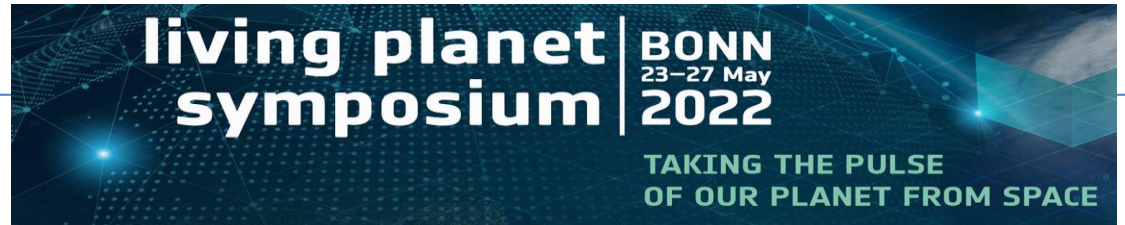
[5] RDIS, Toulouse, France
[6] Airbus Defence and Space, Madrid, Spain
[7] CESBIO, Toulouse, France
[8] ICM-CSIC, Barcelona, Spain
[9] European Space Agency, ESRIN, Frascatti, Italy
[10] Harp Technologies, Espoo, Finland
[11] ODL, Locmaria-Plouzané, France
[12] Deimos Engenheria, Lisbon, Portugal
[13] RDA GmbH, Zurich, Switzerland

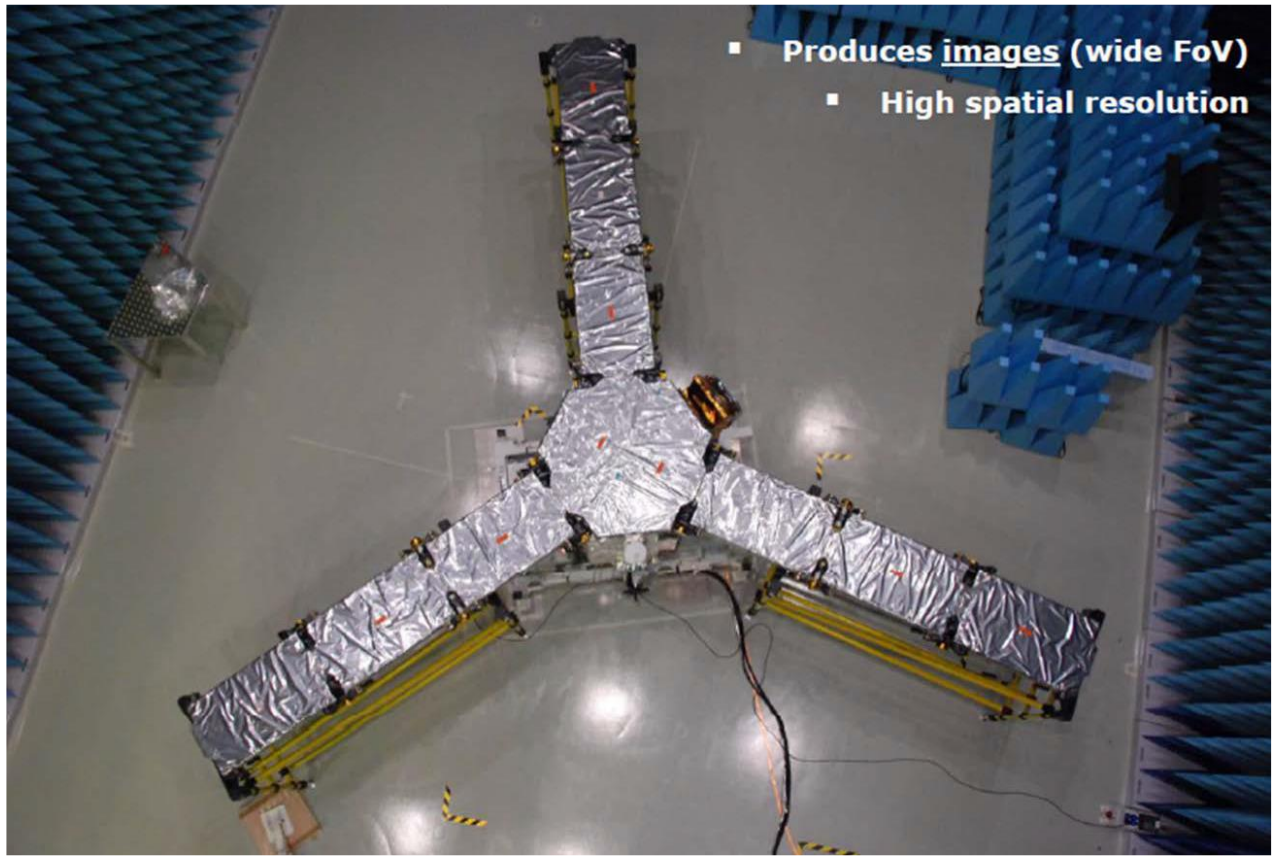


Zenithal Blue Technologies

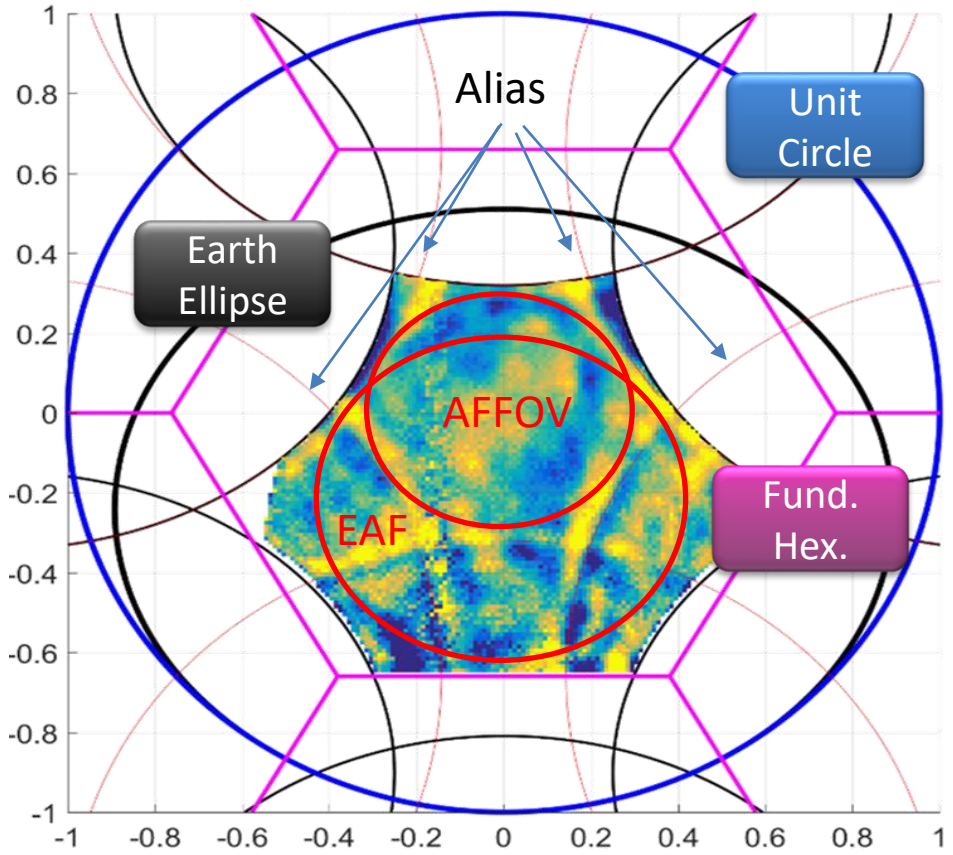
Content

- Introduction
- 3rd Mission REPROCESSING: Data quality
- Focus of Current Investigations
- New products
- Conclusions

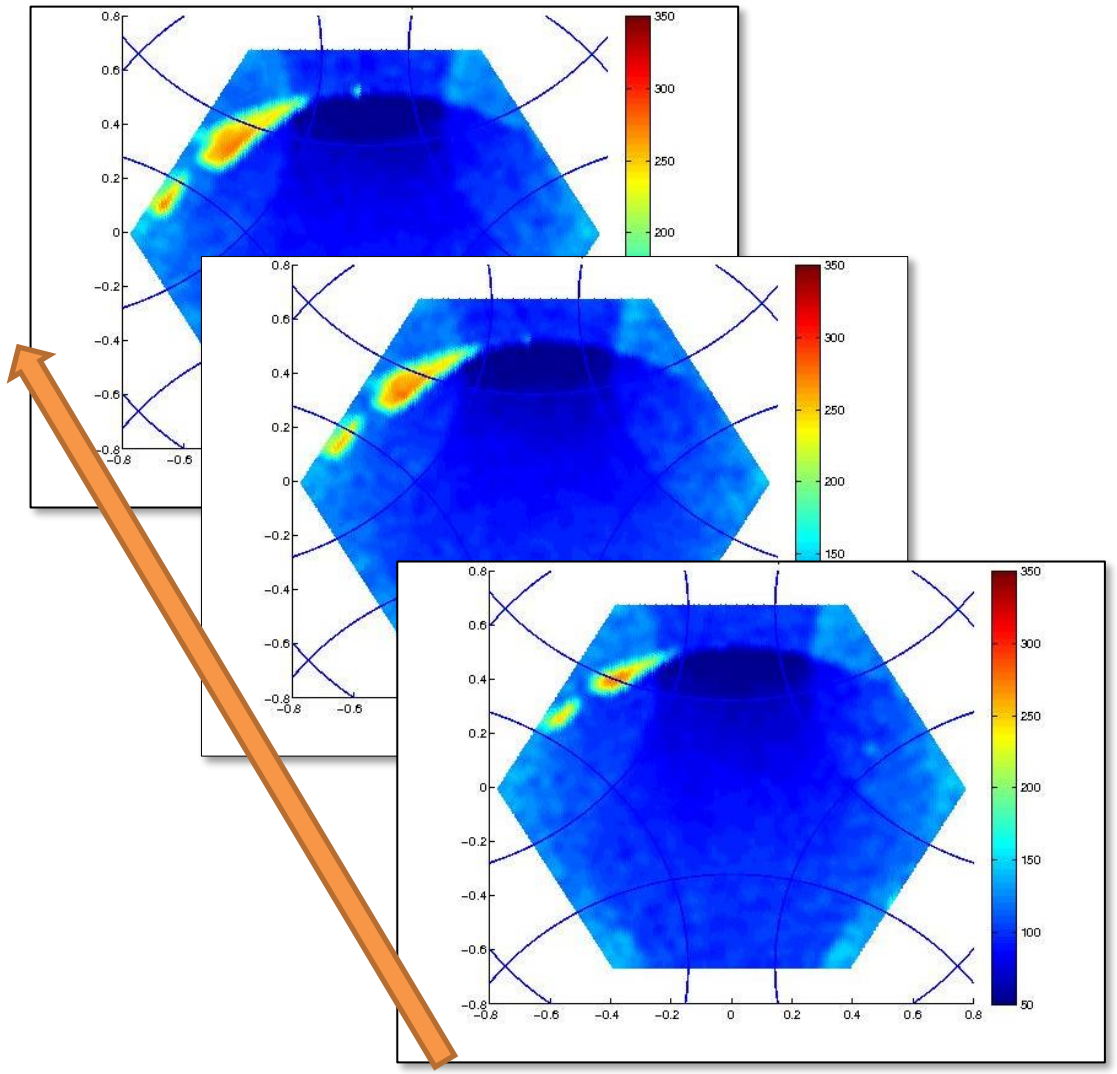
SMOS INSTRUMENT - MIRAS



SMOS Field of View

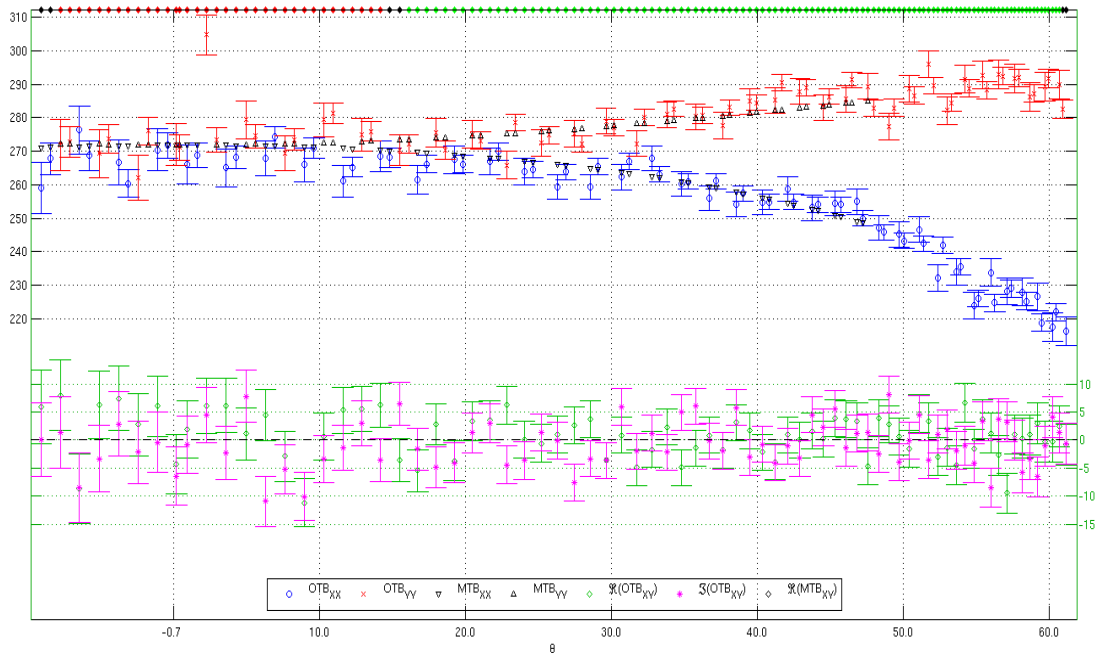


Multi-incidence angle and Polarization



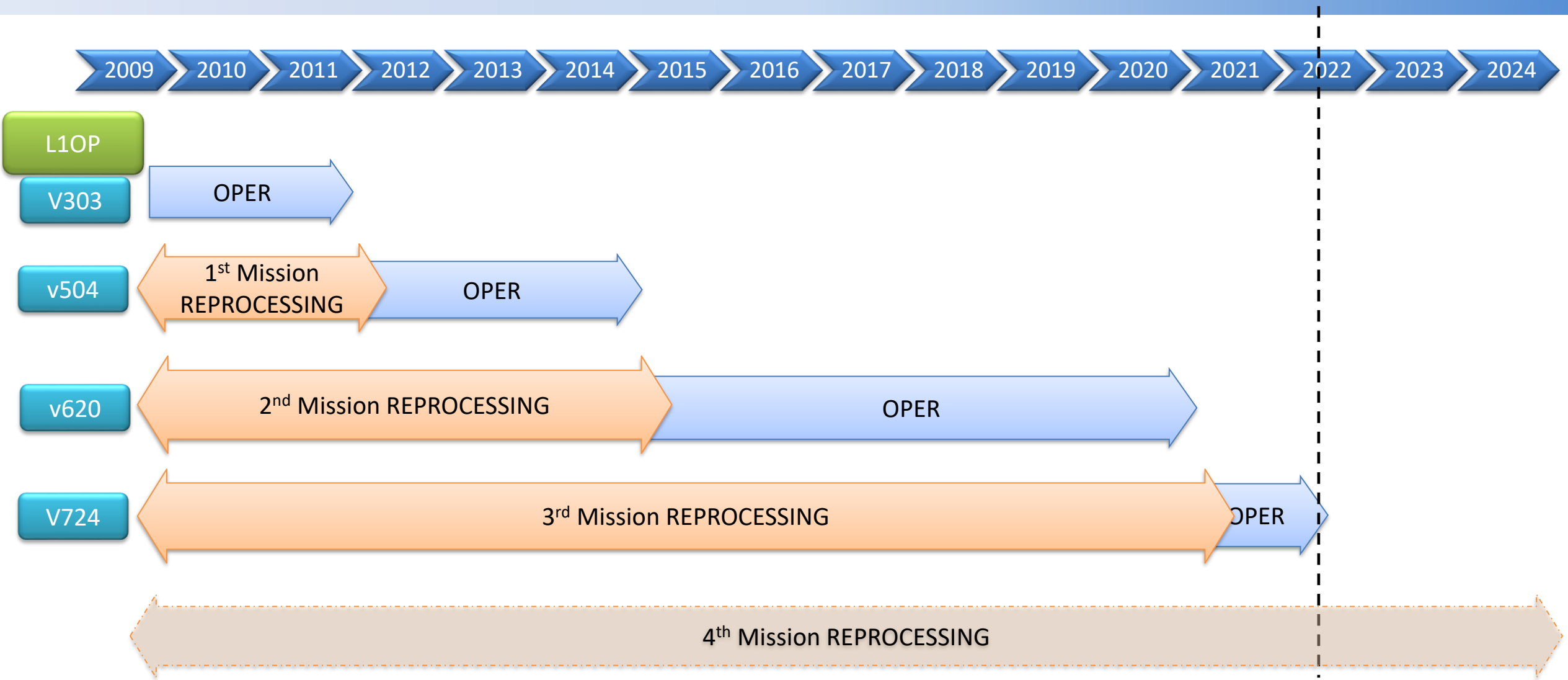
SMOS multi-incidence angle observations

BT



Incidence Angle

SMOS data


2009
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2020
2021
2022
2023
2024
L1OP
V303
OPER
v504
1st Mission REPROCESSING
OPER
v620
2nd Mission REPROCESSING
OPER
V724
3rd Mission REPROCESSING
OPER
4th Mission REPROCESSING

3rd Mission REPROCESSING: Data Quality

Data stability is evaluated with 3 references:

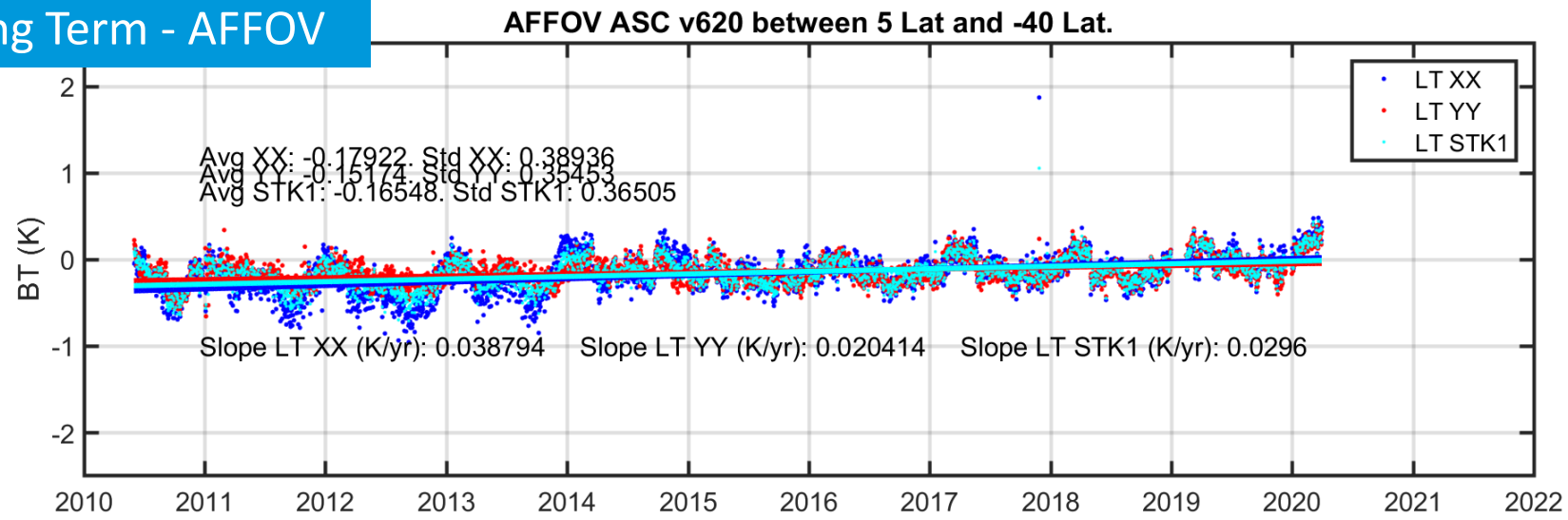
- Ocean Forward model of the BT in stable region using ISAS (In situ Analysis System) to extract SSS
- Dome-C measurements
- SMOS-SMAP Match-ups

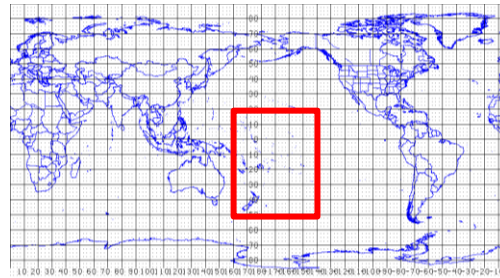
Independently (using SMOS CAL team defined metric):

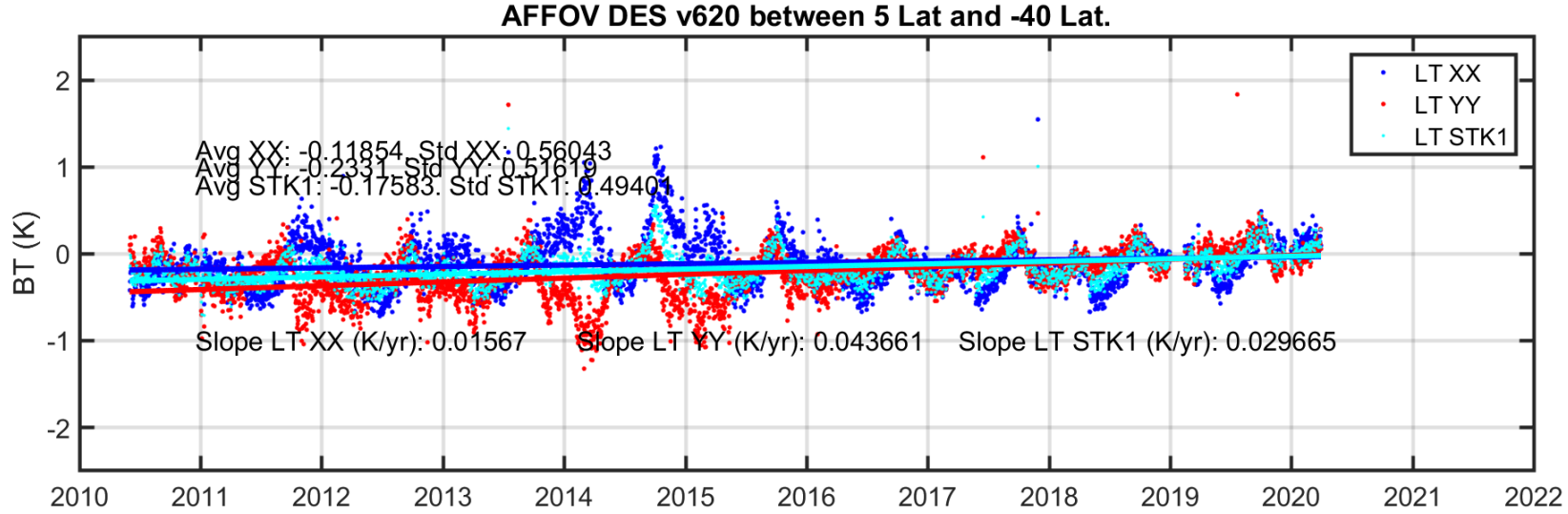
- for X and Y polarizations, Stk-1,3,4
- For different parts of the Field of View
- for Ascending and Descending orbits

LONG TERM STABILITY METRICS OVER OCEAN

Long Term - AFFOV

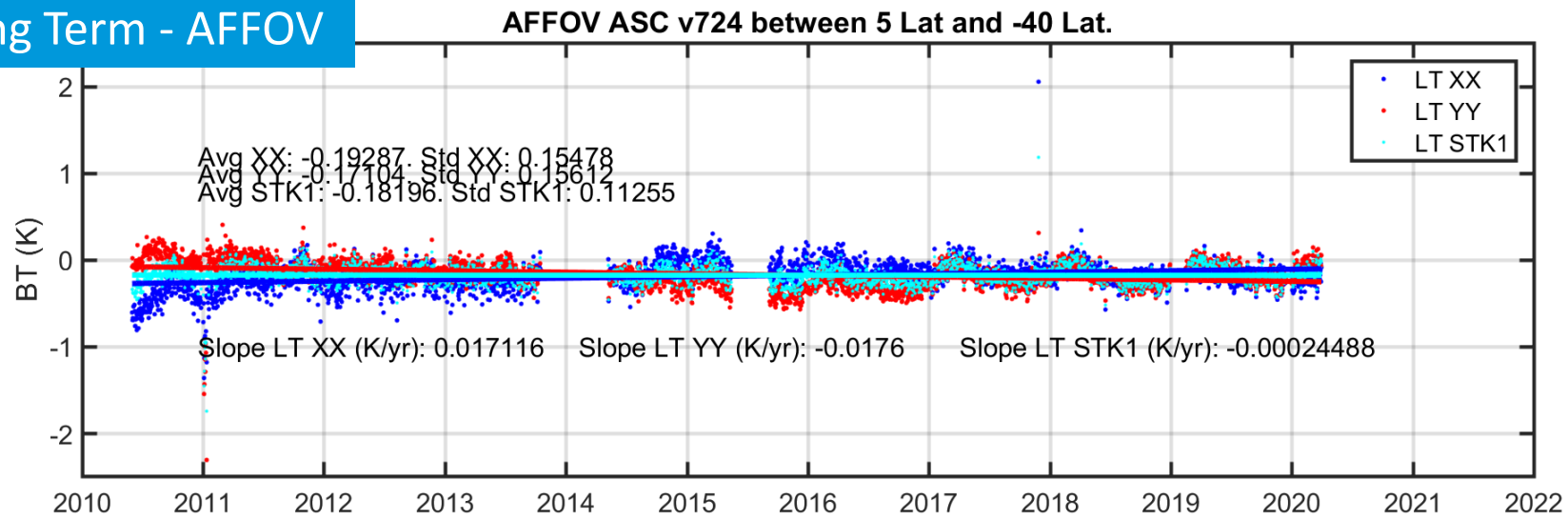


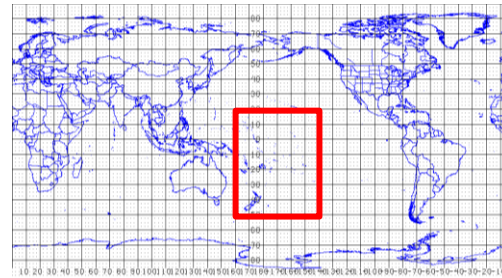


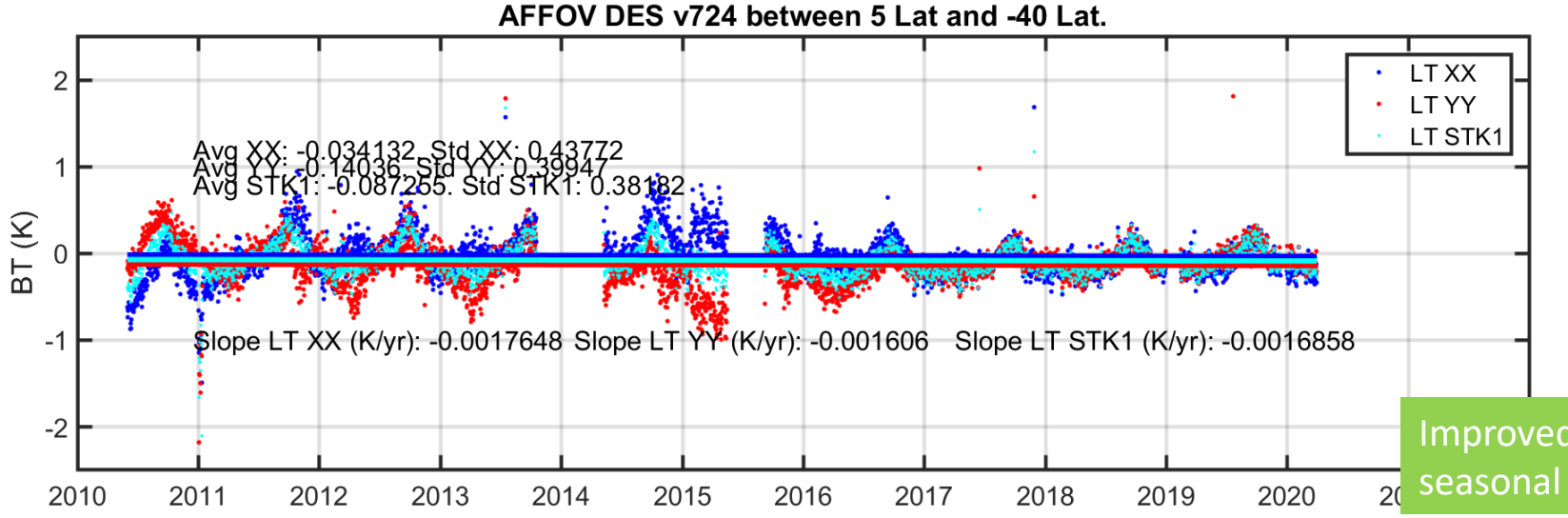


LONG TERM STABILITY METRICS OVER OCEAN

Long Term - AFFOV





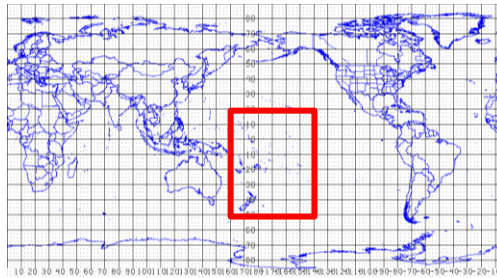


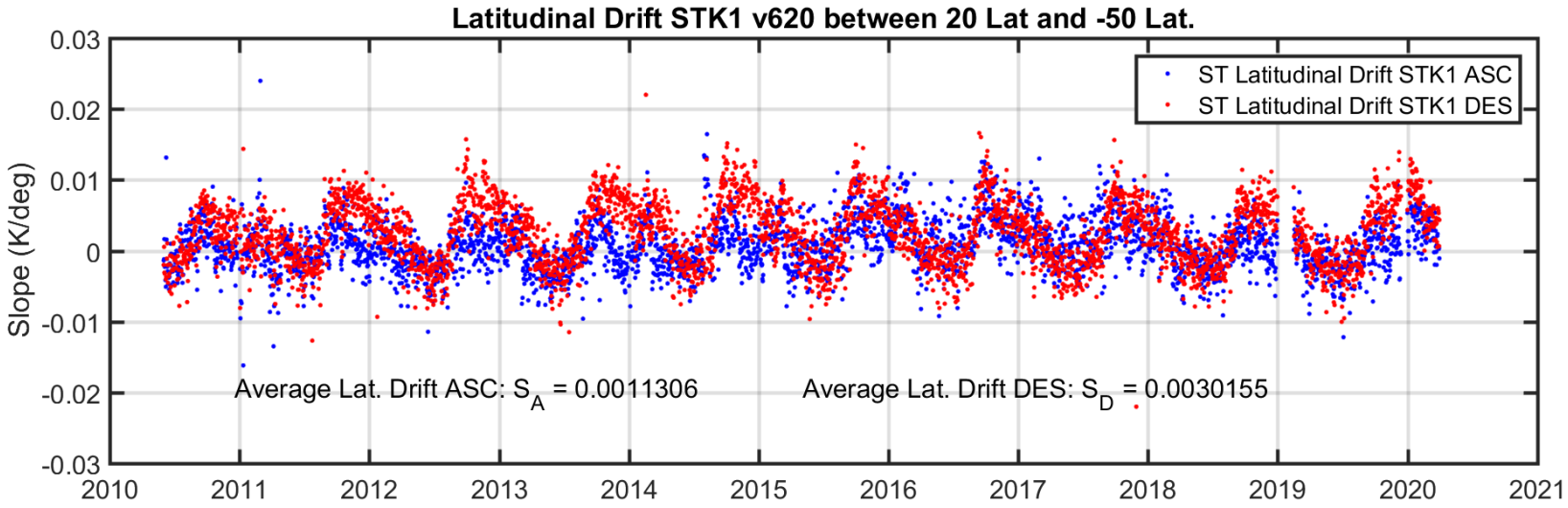
Improved LT & seasonal variation

SHORT TERM STABILITY METRICS OVER OCEAN

Short Term – Latitudinal Drift: AFFOV

Slope of the daily latitudinal slice





SHORT TERM STABILITY METRICS OVER OCEAN

Short Term – Latitudinal Drift: AFFOV

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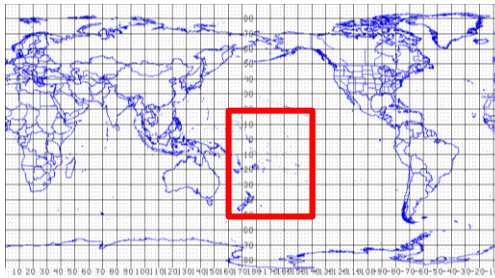
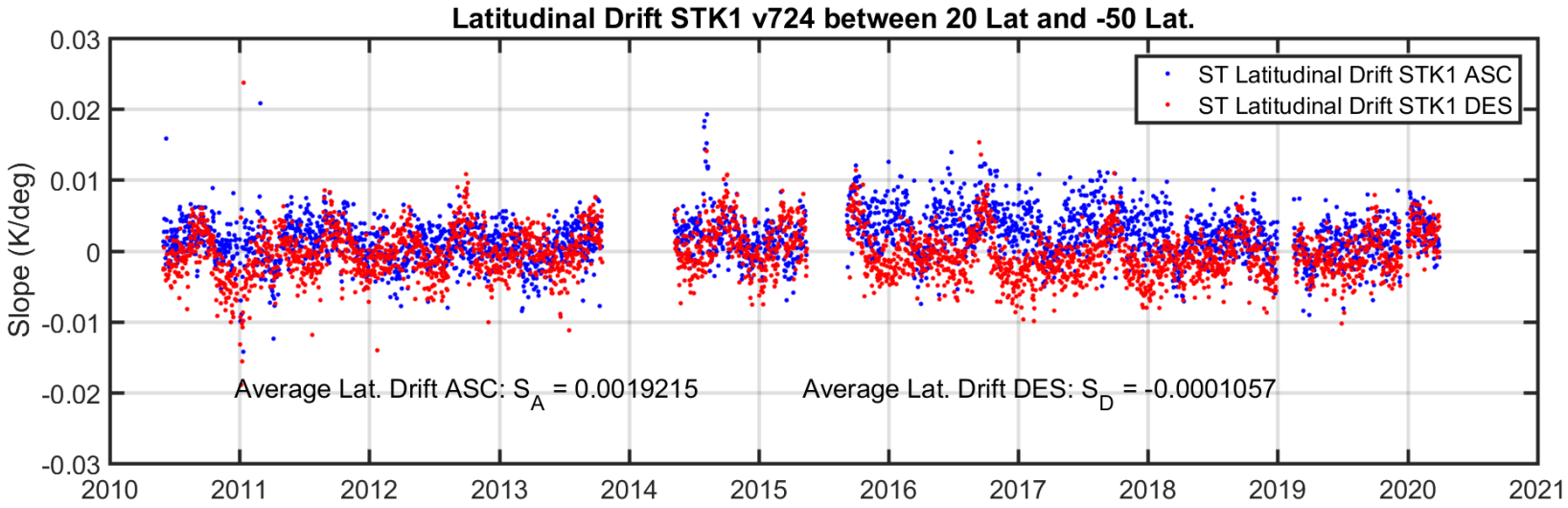




Improved Latitudinal Drift Seasonality

Slightly degraded Avg Lat. Drift for ascending orbits, particularly 2016-2018

Long & Short term metrics summary table

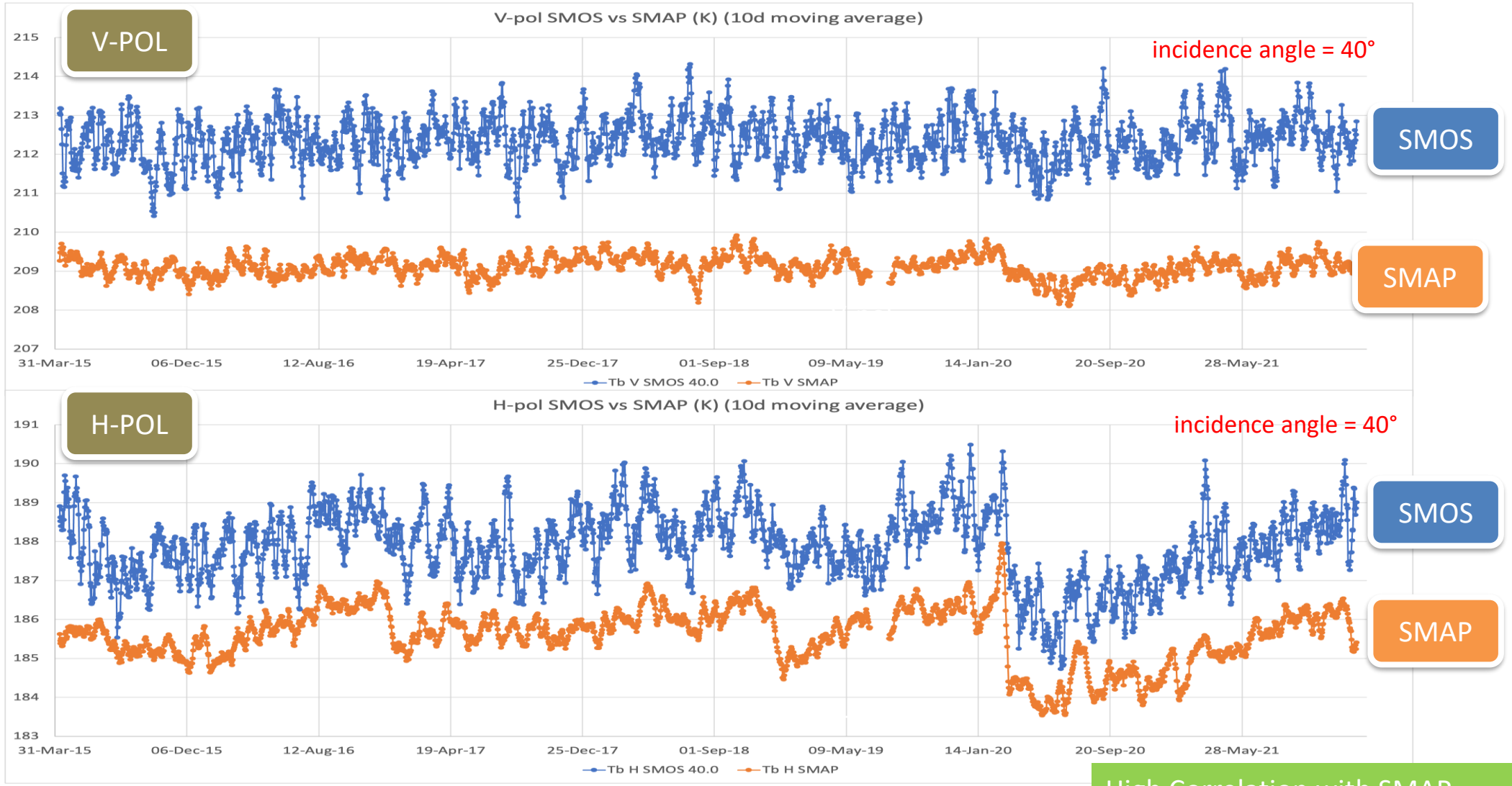
AF-FOV

	Metric AFFOV	Units	v620	v724
ASC	Long Term XX	[mK/yr]	38	17
	Long Term YY	[mK/yr]	20	-18
	Long Term Stk1	[mK/yr]	30	0
	Seasonal var. X	[K]	0.39	0.15
	Seasonal var. Y	[K]	0.35	0.16
	Seasonal var. Stk1	[K]	0.37	0.11
	Lat. Drift	[mK/deg]	1.1	1.9
DES	Long Term XX	[mK/yr]	16	-2
	Long Term YY	[mK/yr]	44	-2
	Long Term Stk1	[mK/yr]	30	-2
	Seasonal var. X	[K]	0.56	0.44
	Seasonal var. Y	[K]	0.52	0.40
	Seasonal var. Stk1	[K]	0.49	0.38
	Lat. Drift	[mK/deg]	3.0	-0.1
	Lat. Drift Eclipse	[mK/deg]	7.3	1.4
DESC-ASC	Diff ASC-DES	[K]	0.26	0.25

EAF-FOV

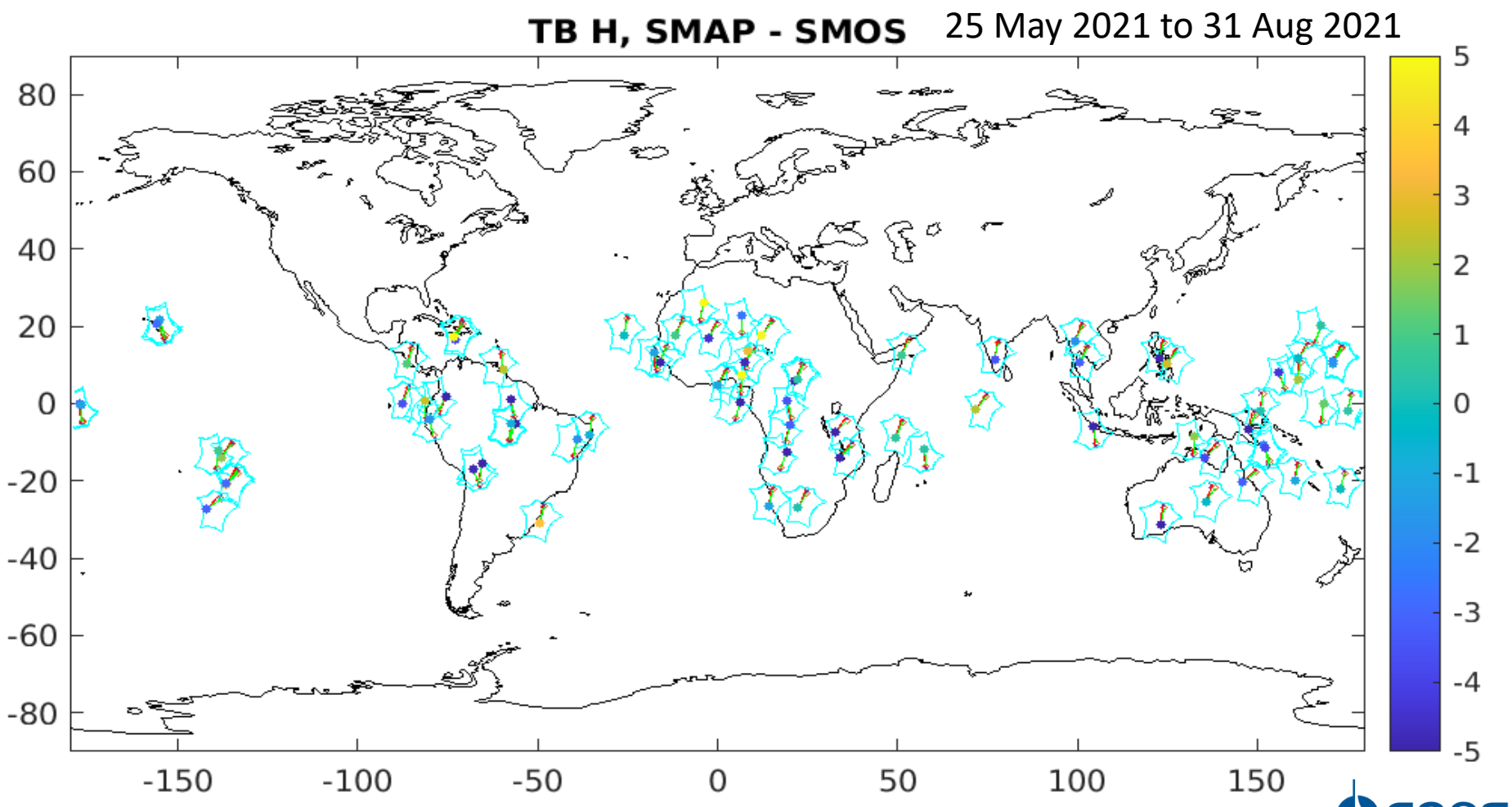
Metric EAF	Units	v620	v724
Long Term XX	[mK/yr]	80	54
Long Term YY	[mK/yr]	46	-11
Long Term Stk1	[mK/yr]	63	21
Seasonal var. X	[K]	0.47	0.31
Seasonal var. Y	[K]	0.42	0.23
Seasonal var. Stk1	[K]	0.43	0.21
Lat. Drift	[mK/deg]	0.8	3.1
Long Term XX	[mK/yr]	68	42
Long Term YY	[mK/yr]	43	-10
Long Term Stk1	[mK/yr]	55	16
Seasonal var. X	[K]	0.67	0.52
Seasonal var. Y	[K]	0.66	0.62
Seasonal var. Stk1	[K]	0.65	0.54
Lat. Drift	[mK/deg]	5.3	0.4
Lat. Drift Eclipse	[mK/deg]	1.8	-7.8
Diff ASC-DES	[K]	0.43	0.38

LONG TERM STABILITY OVER DOME-C: SMOS vs SMAP



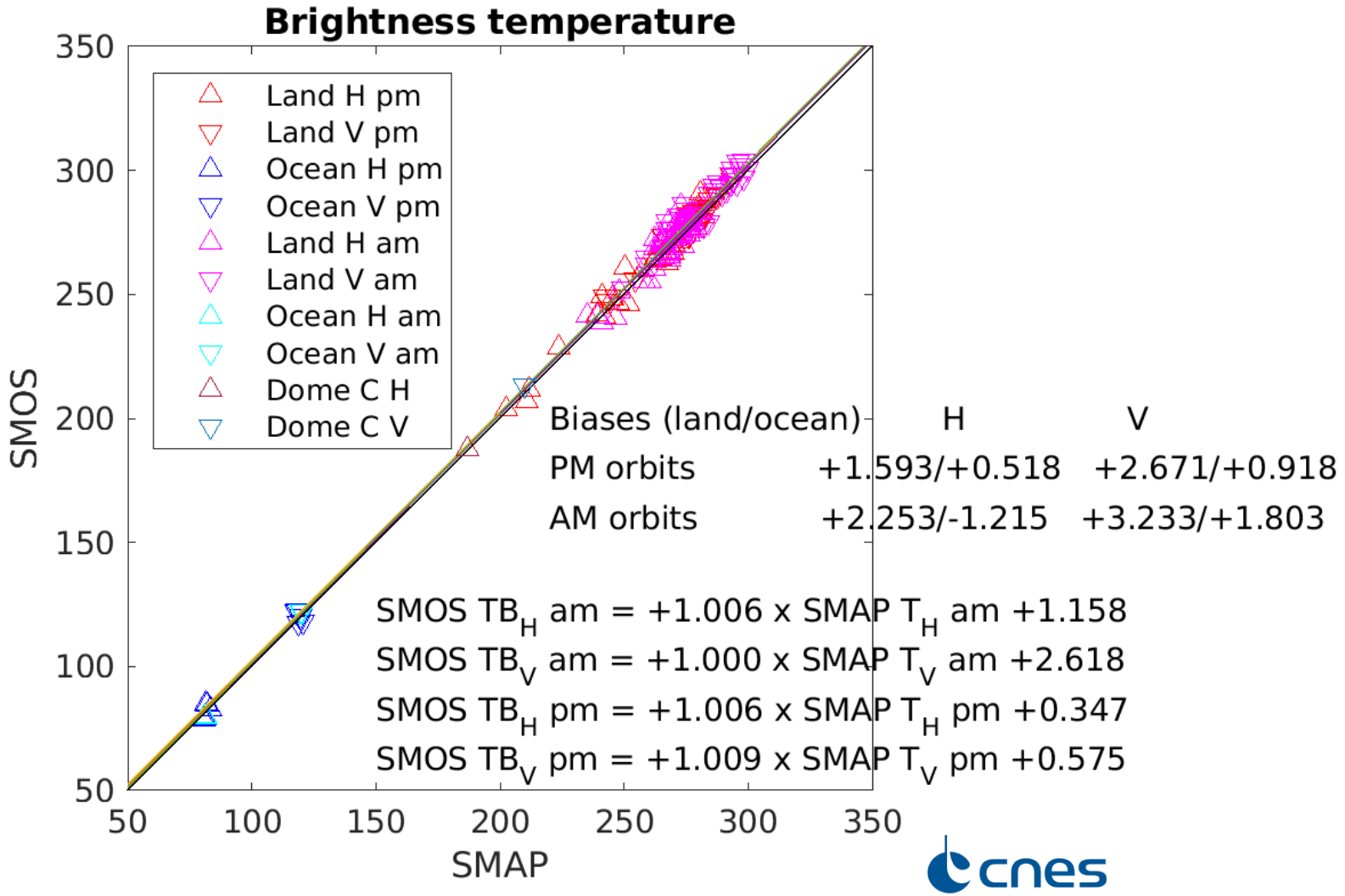
High Correlation with SMAP

SMOS – SMAP match-ups



cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

SMOS – SMAP matchups



cnes
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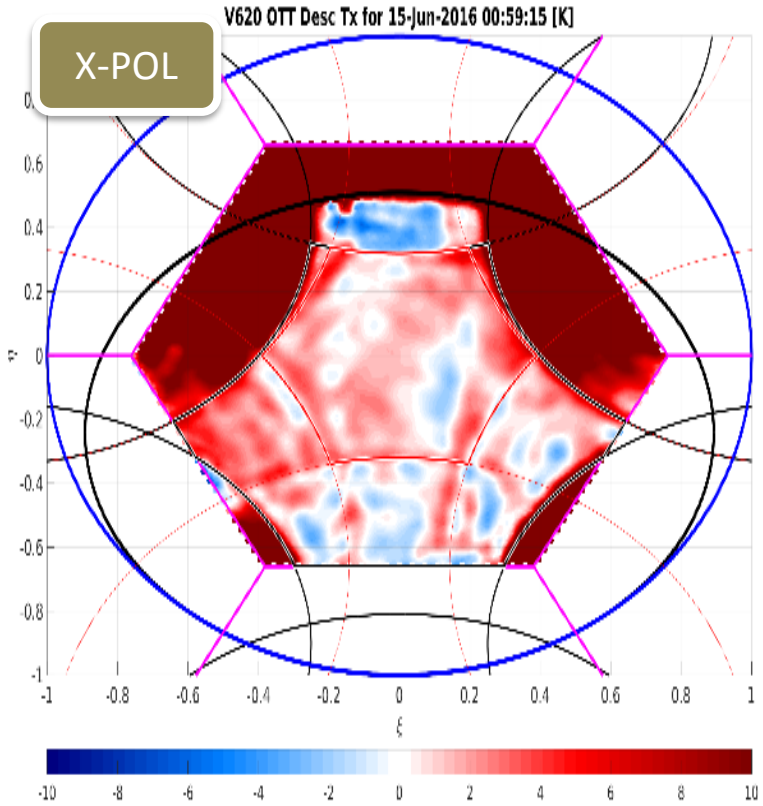
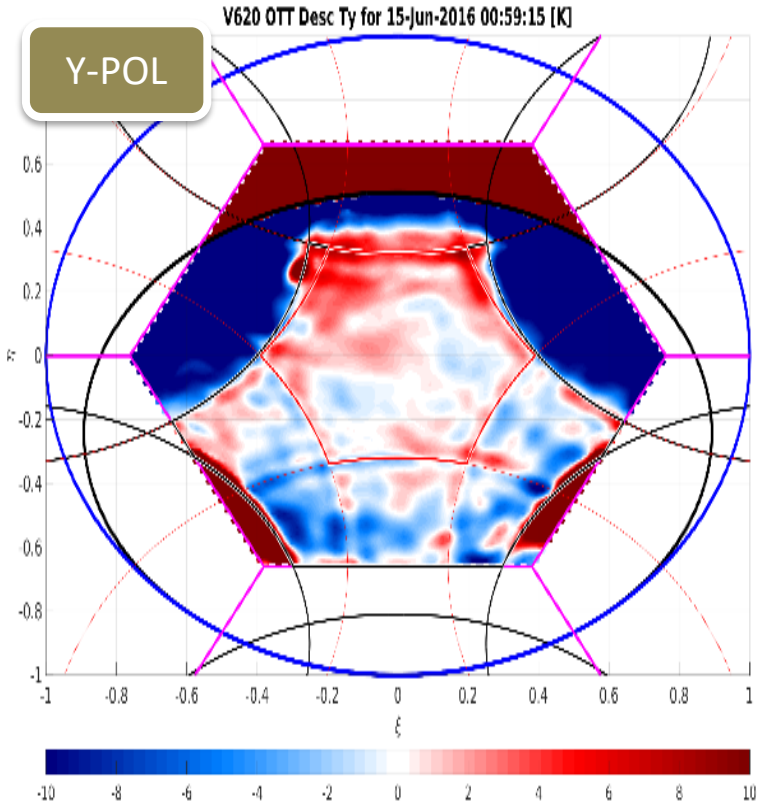
Spatial biases

X-POL

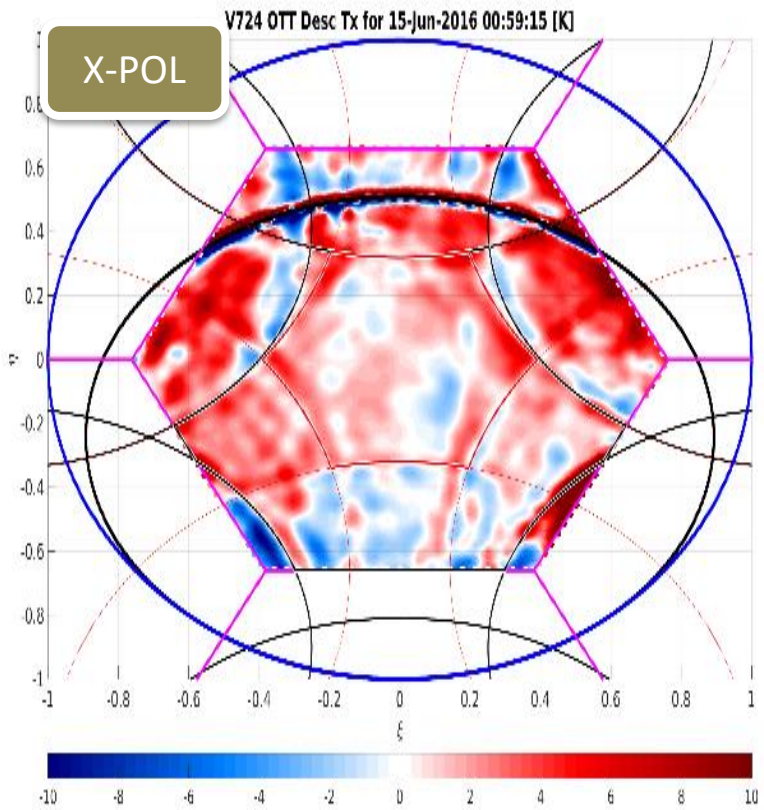


v620

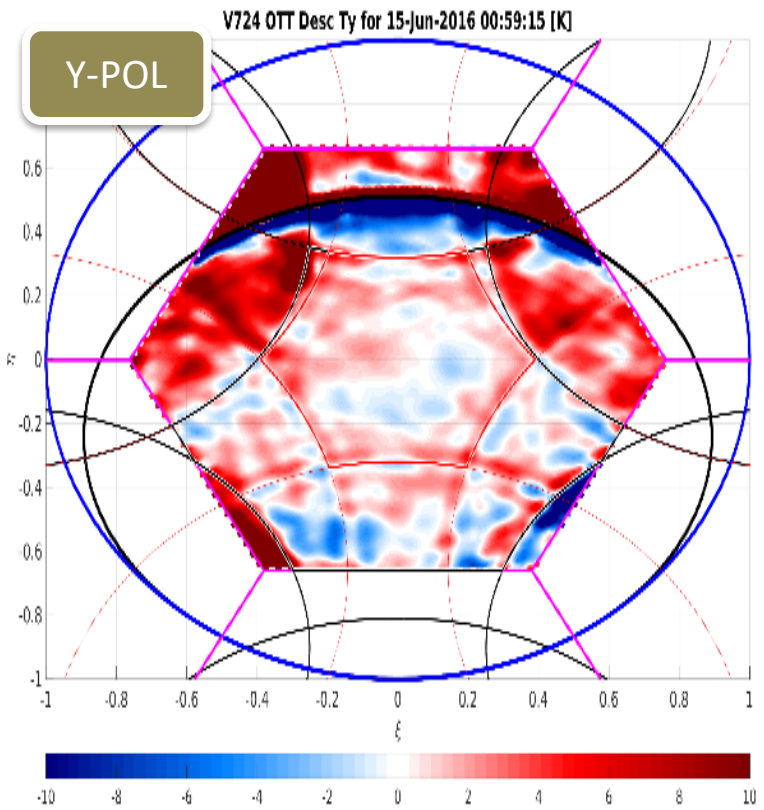
Y-POL



Spatial biases



v724

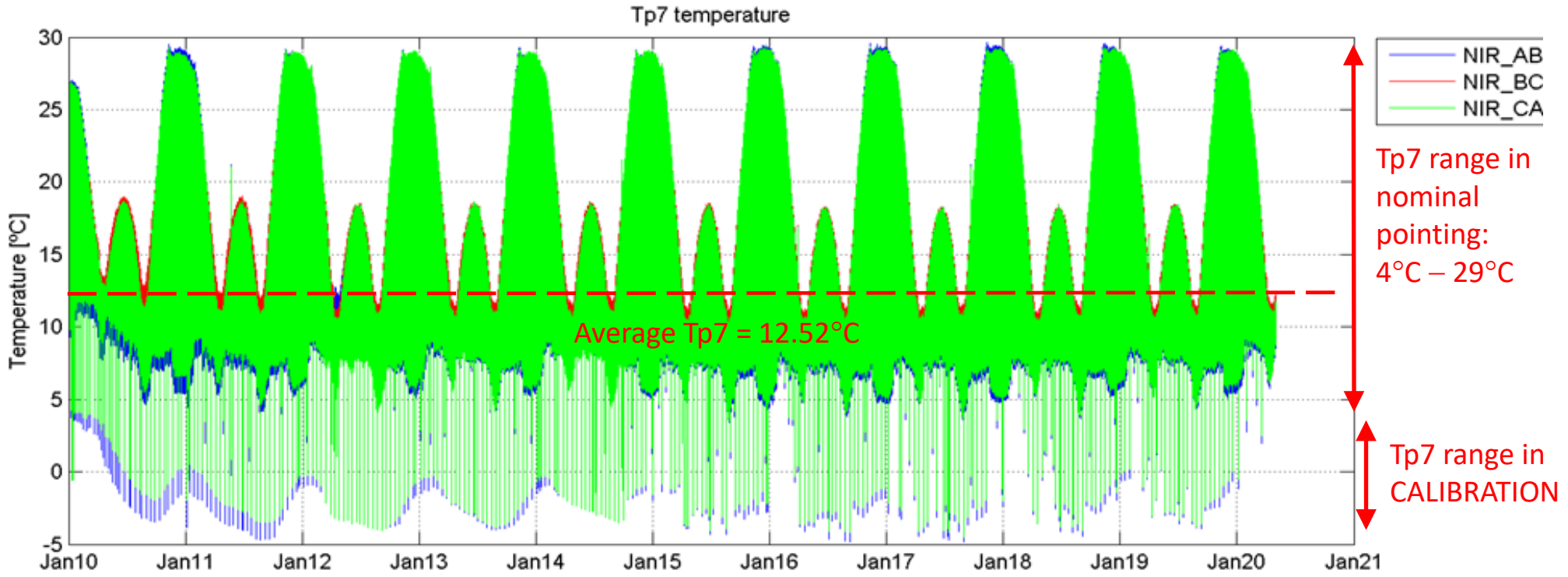


Important reduction of the dwell line negative slope in Ty

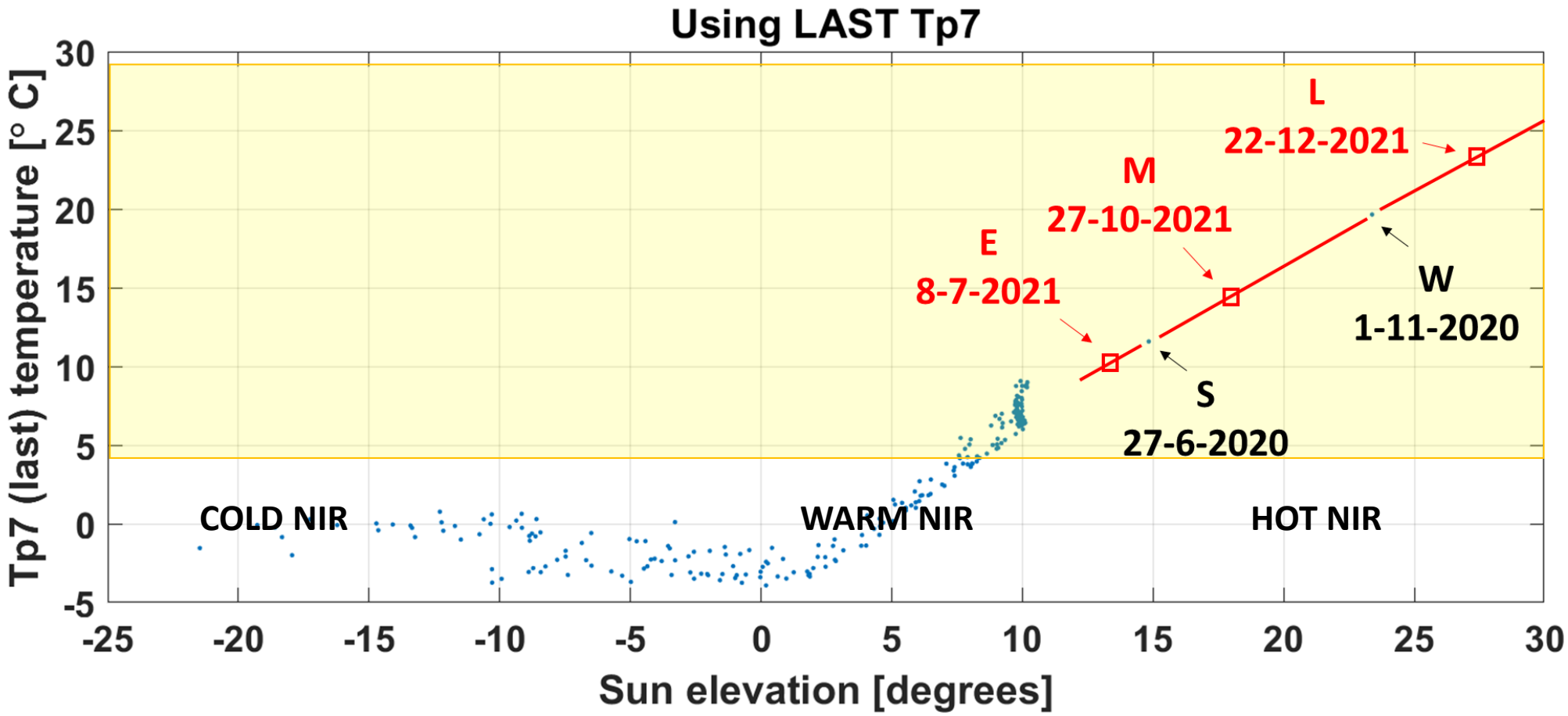
Focus of current investigations

Temperature during Calibration

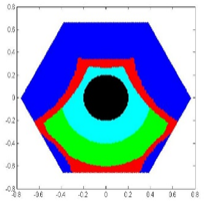
Temperature at the NIR antenna patches



Cold, Warm and Hot NIR Calibrations



Latitudinal drift during eclipse

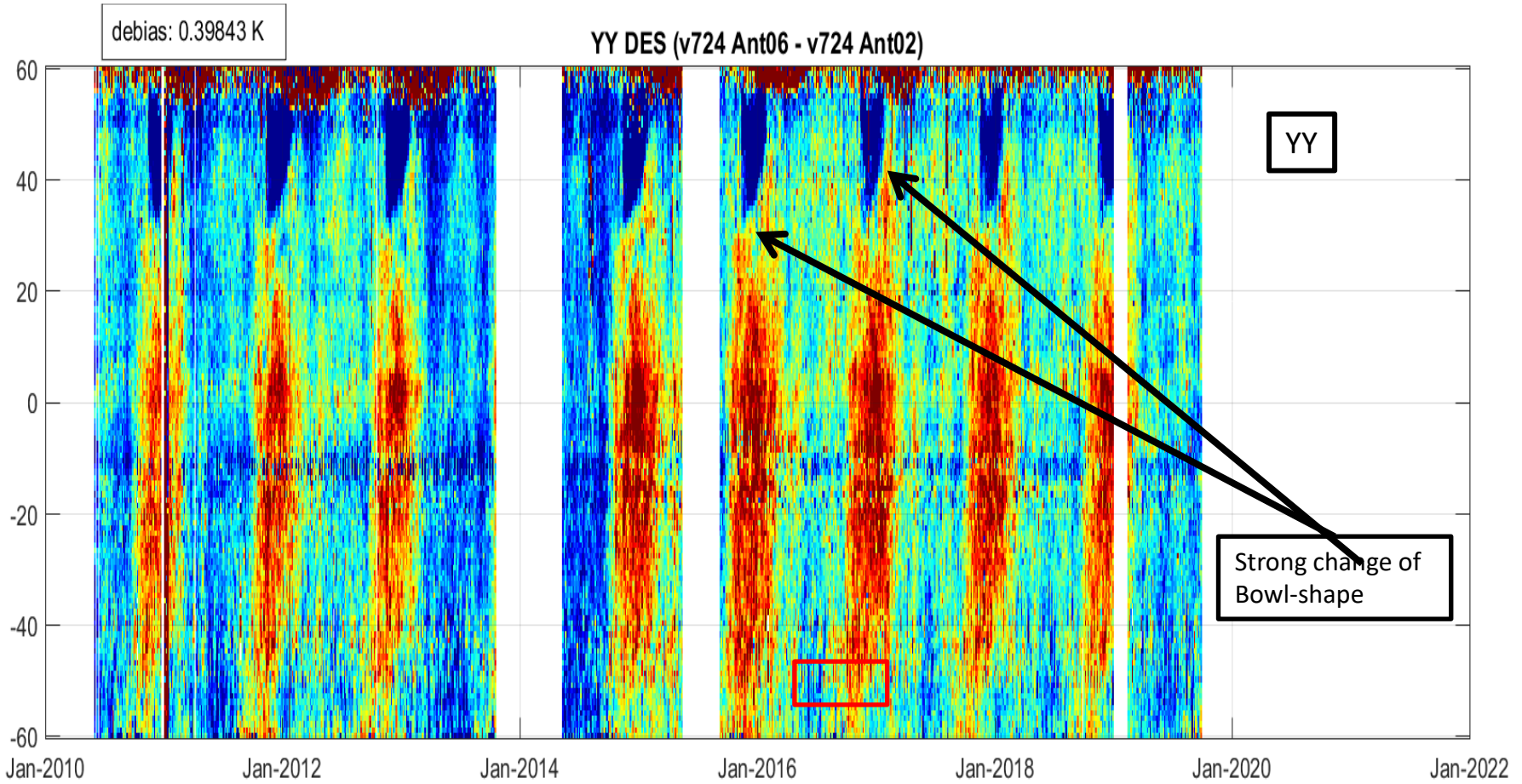


Antenna 02
Antenna 04
Antenna 06

Bowlshape ≡ (Bias Antenna 06 – Bias Antenna 02)

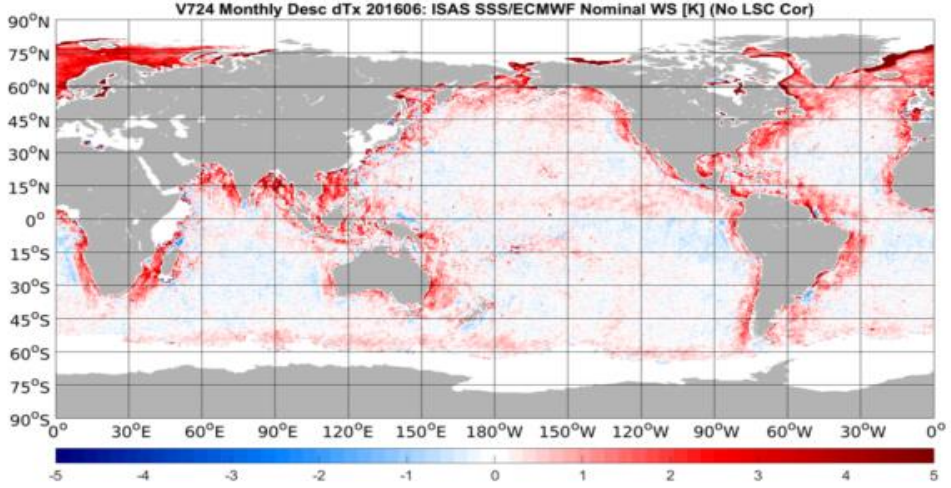
Positive = Concave

Negative = Convex

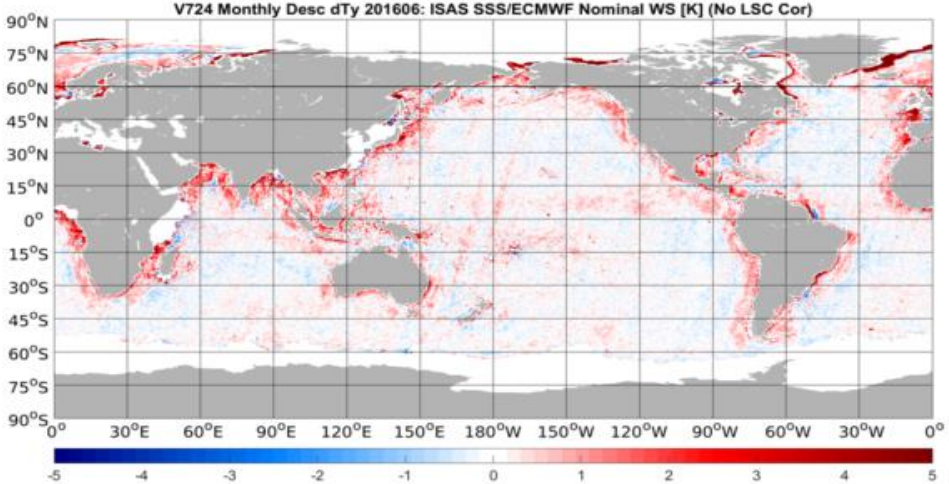


Land Sea contamination

Tx

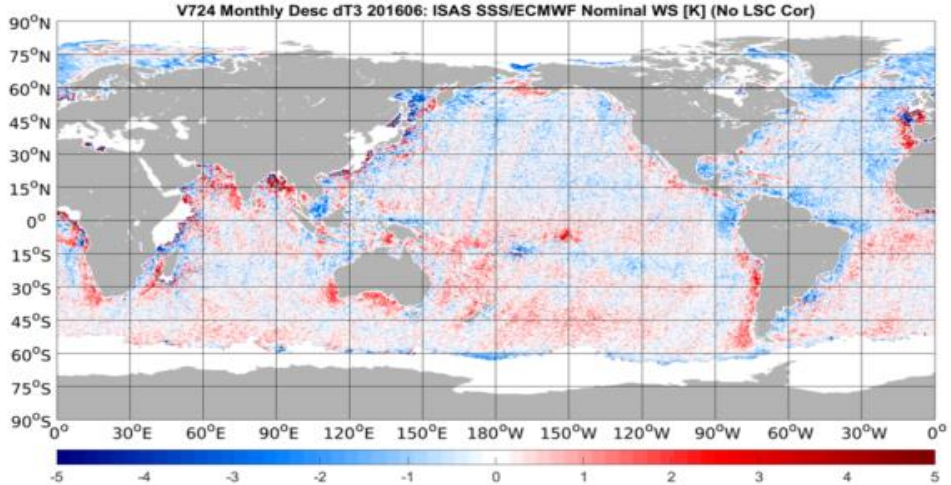


Ty

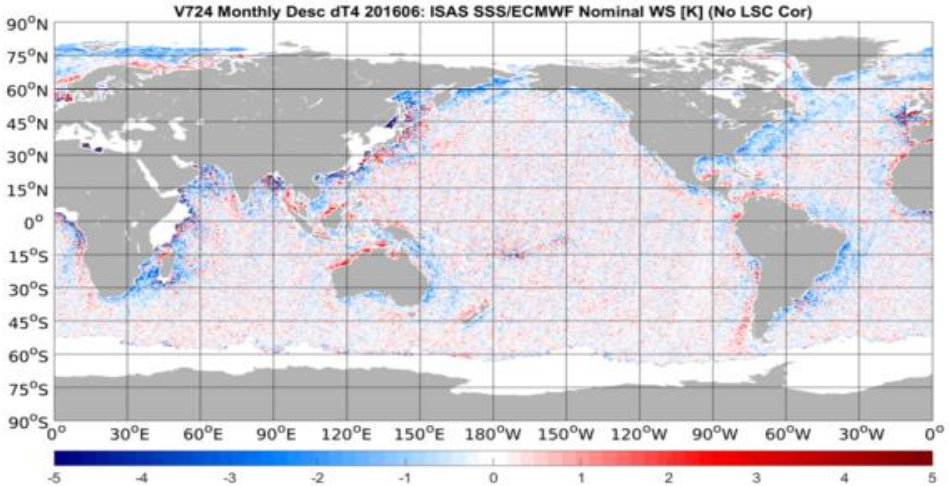


v724: Descending

T3

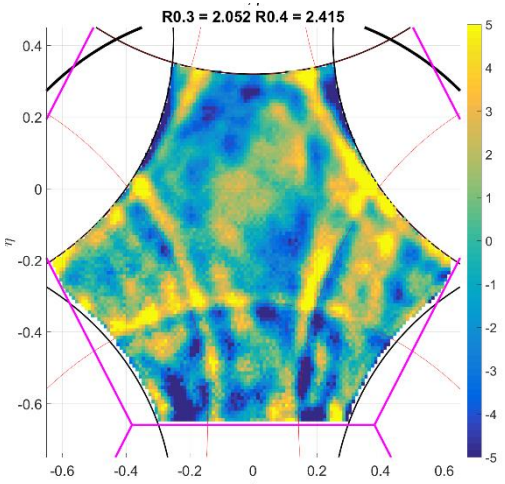


T4



Remaining Spatial Biases

DOMEC



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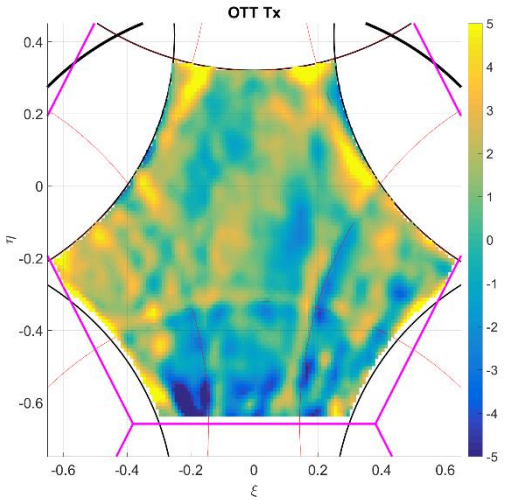
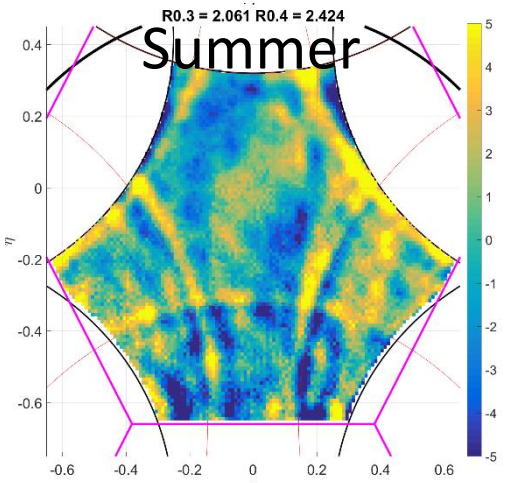
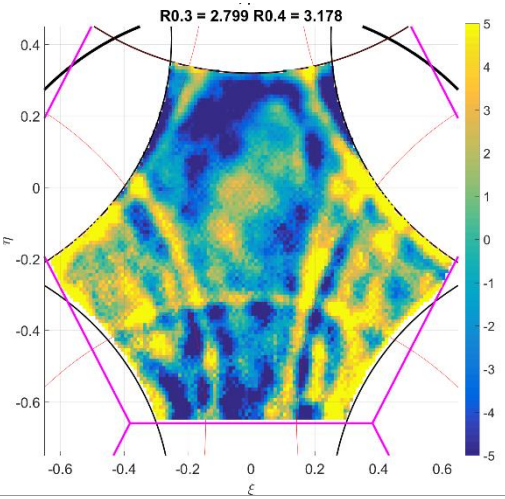


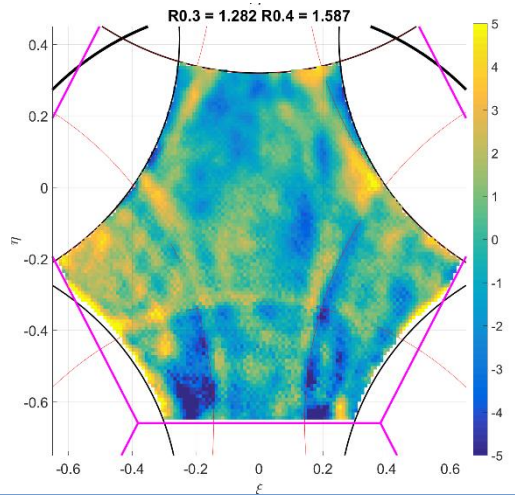
A.C.P Summer



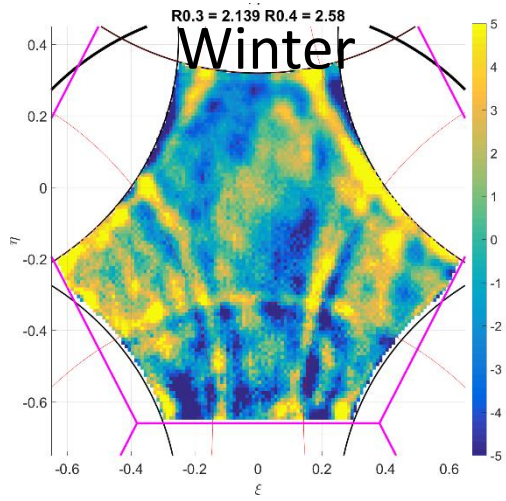
Amazon



Sea Asc



A.C.P Winter



Remaining Spatial Biases

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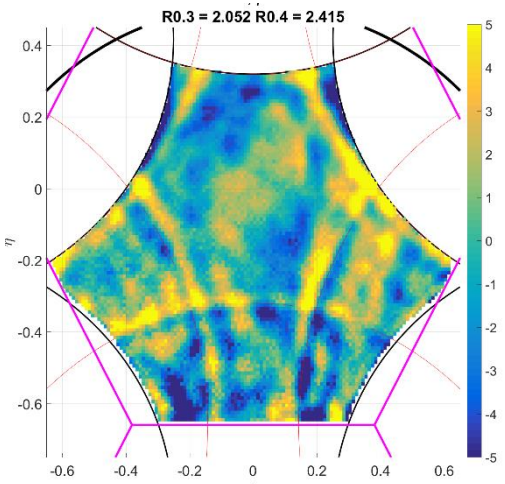

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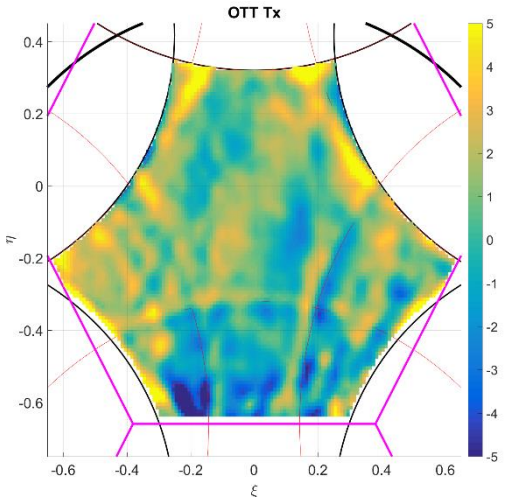

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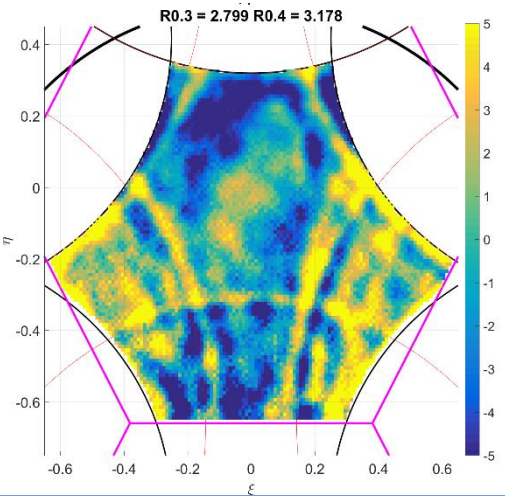
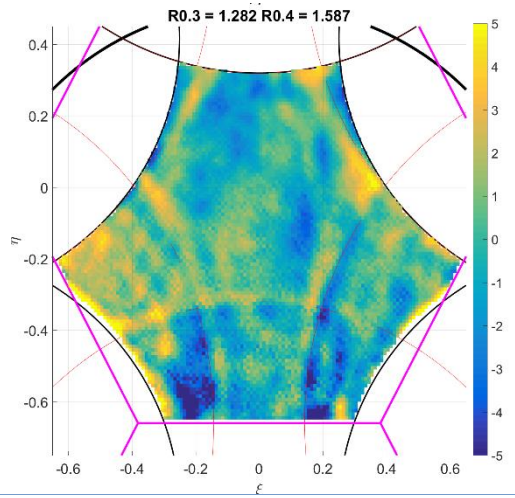
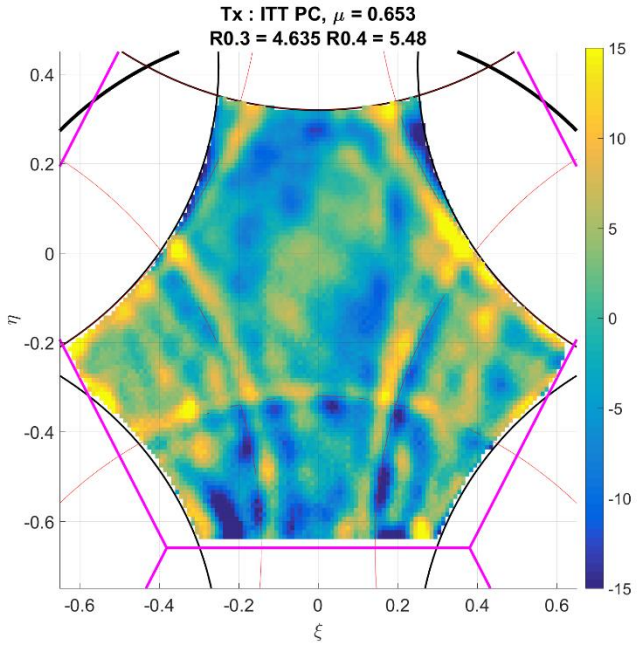


Sea Asc

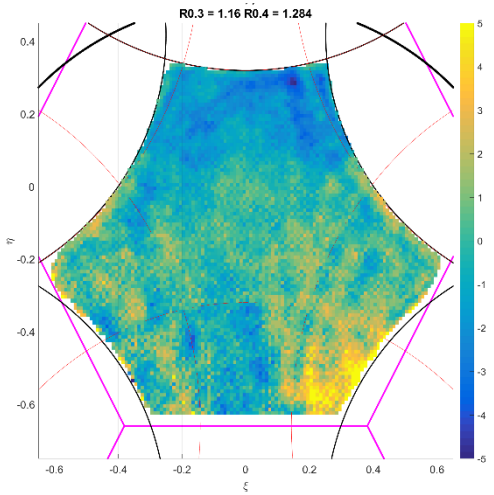




Spatial Bias 1st PCA Mode (SB-PC)

Spatial Bias Tx SB-PC Removed

Amazon



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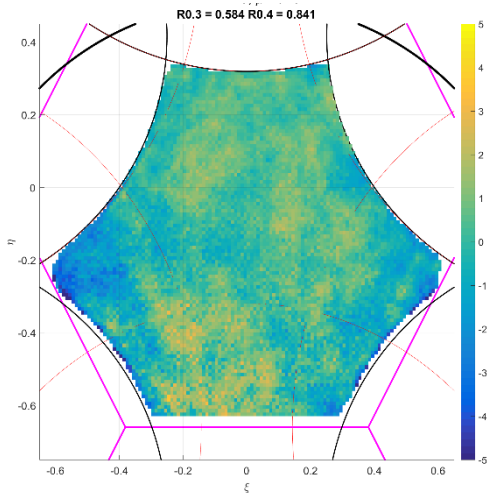
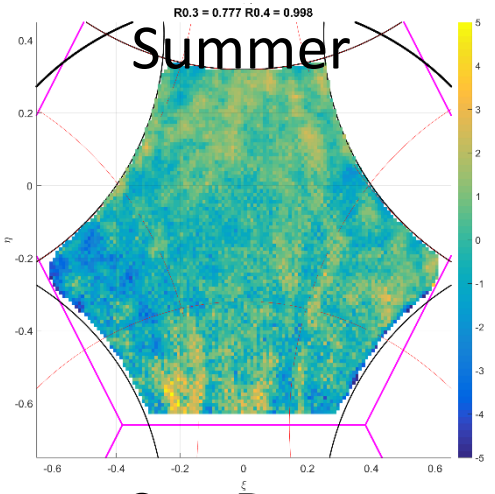
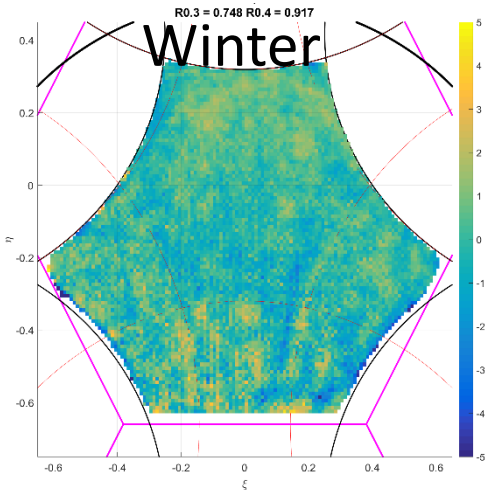


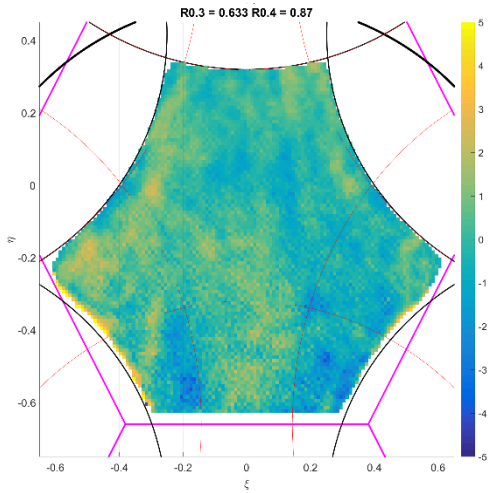
A.C.P Summer



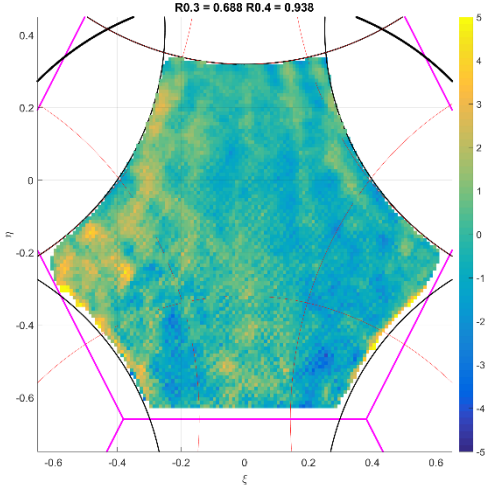
A.C.P Winter



Sea Asc

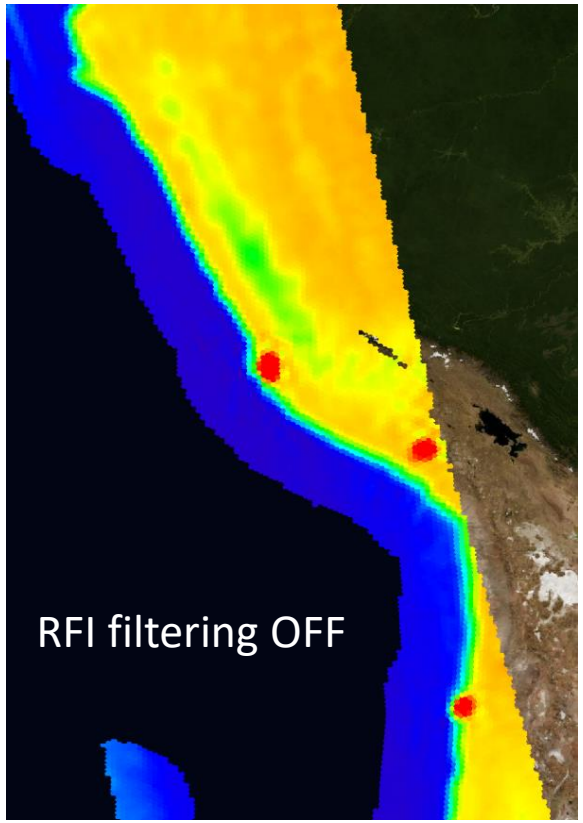


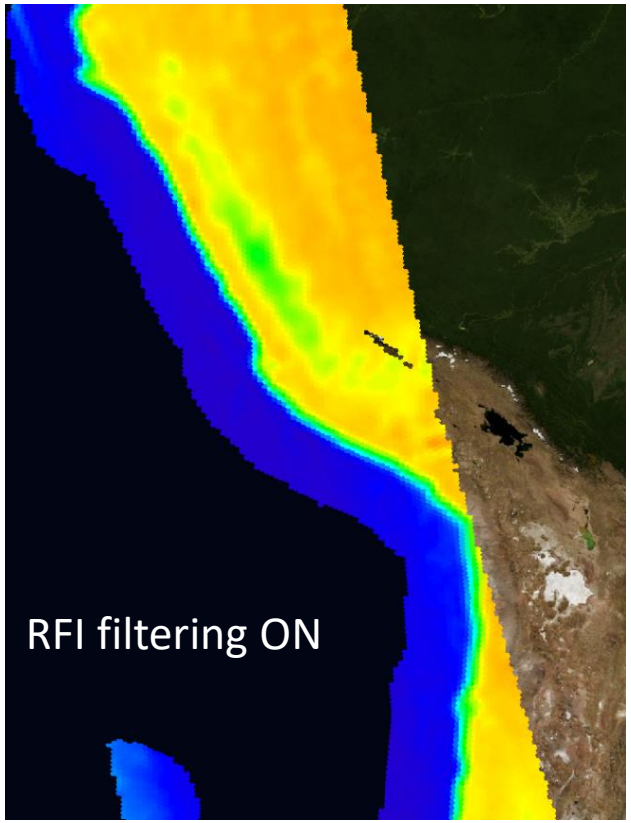
Sea Desc



RFI

SMOS team is looking into modeling and filtering RFI signals.

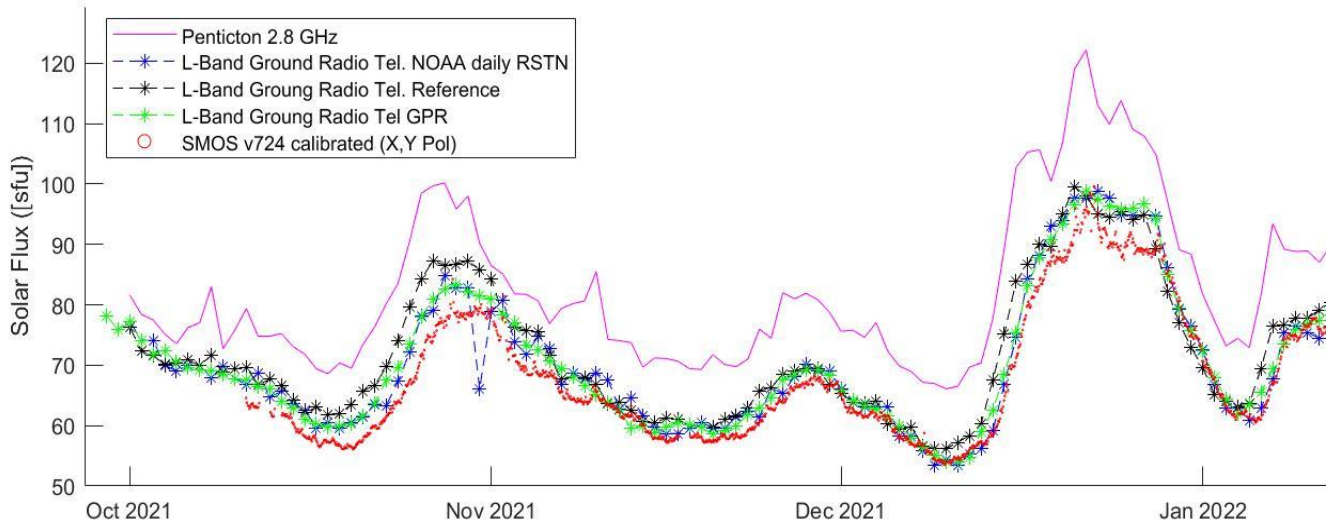




Works well only on isolated RFI sources

New Products

SMOS Solar Flux

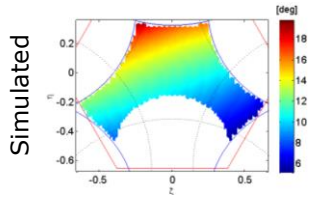


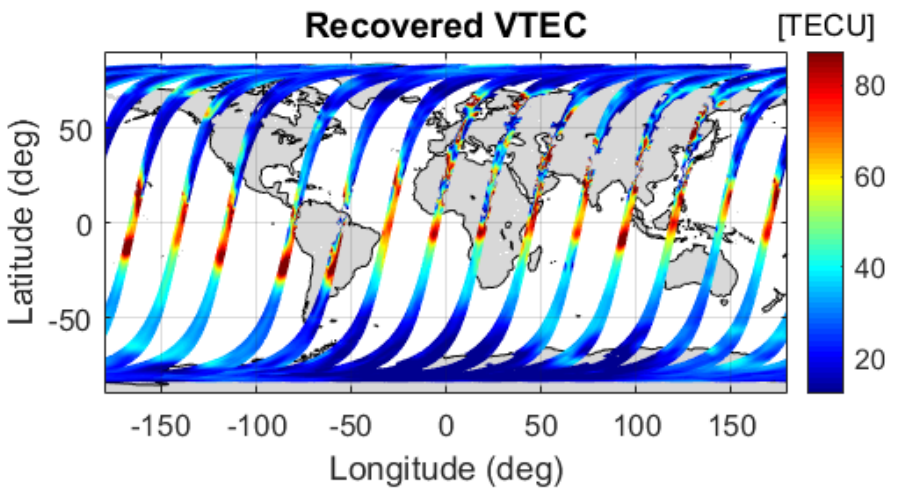
SMOS Derived TEC

2. FRA recovery

FRA recovery of every snapshot (ia>25°) with

$$\Omega_f^m = -ra - \frac{1}{2}\tan^{-1}\left(\frac{2\Re e\left(T_B^{xy}\right)}{T_B^{xx} - T_B^{yy}}\right)$$





CONCLUSIONS

- Payload and platform working well after more than 12 years
- Instrument measurements are extremely stable in the Long term
- Some thermal variations during eclipse periods still present
- New L1 products emerging
- Efforts are put in reducing the residual spatial biases, RFI signal and in the latitudinal variations, with promising techniques