Assessing the impacts of assimilating satellite SST in addition to along-track SLA into a HYCOM model of the Agulhas Current System

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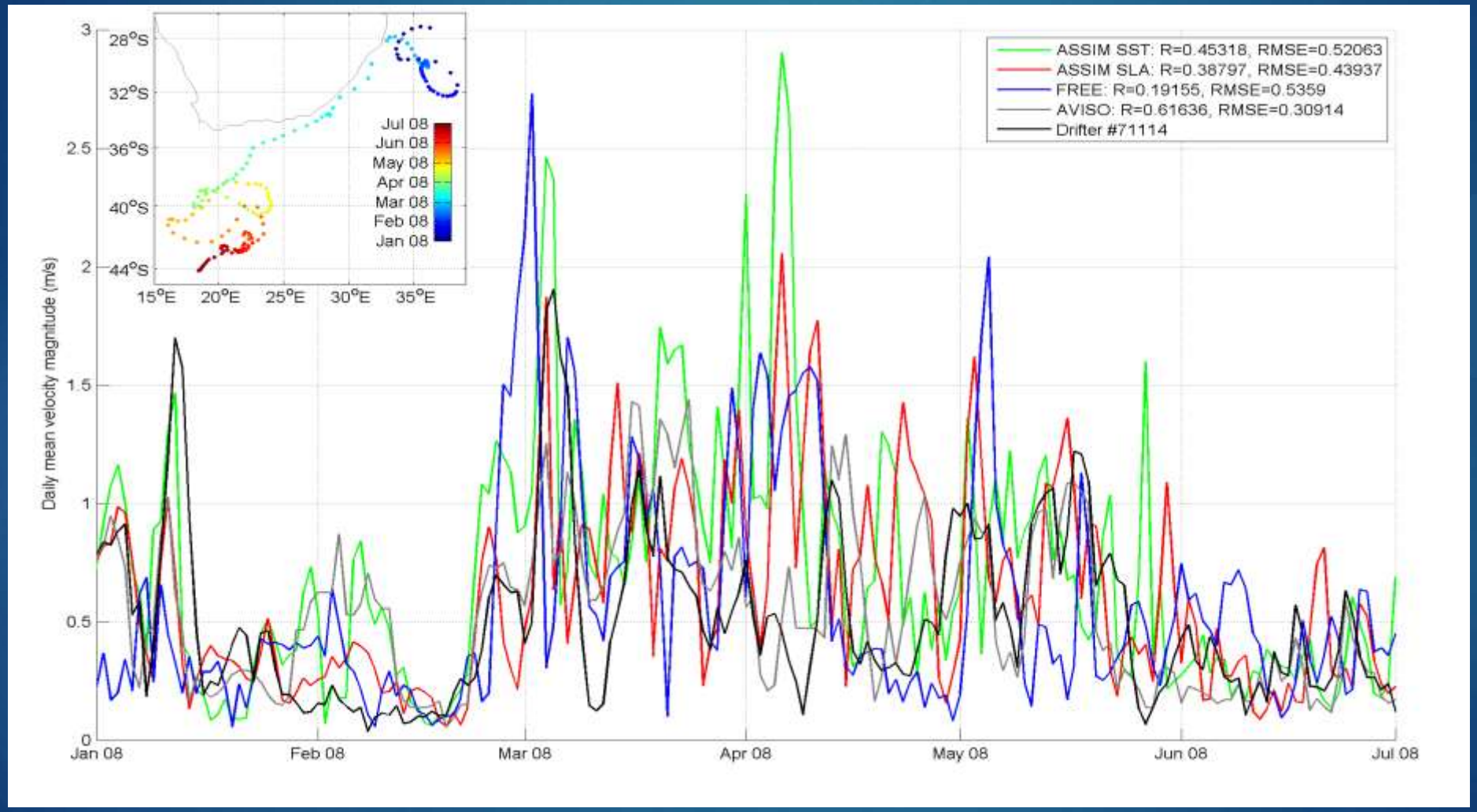
Introduction

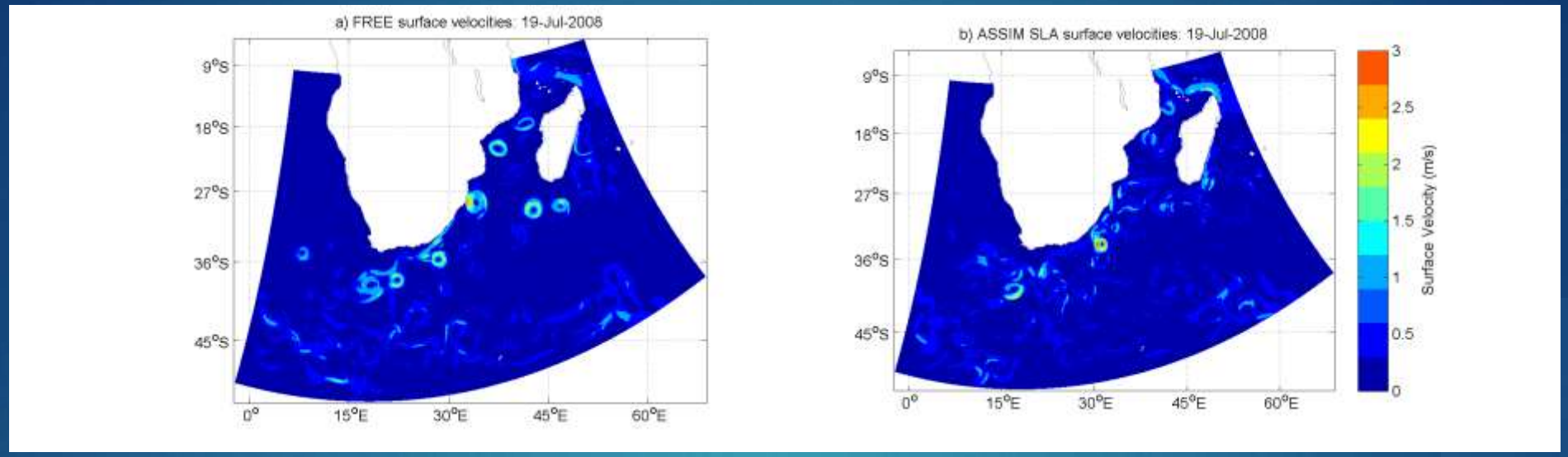
- Continuation of previous study carried out in 2014
- Looked at impacts of assimilating along-track SLA only
- There were some limitations
- Additional assimilation of SST hoping to improve results
- End goal to create regional ocean forecasting system

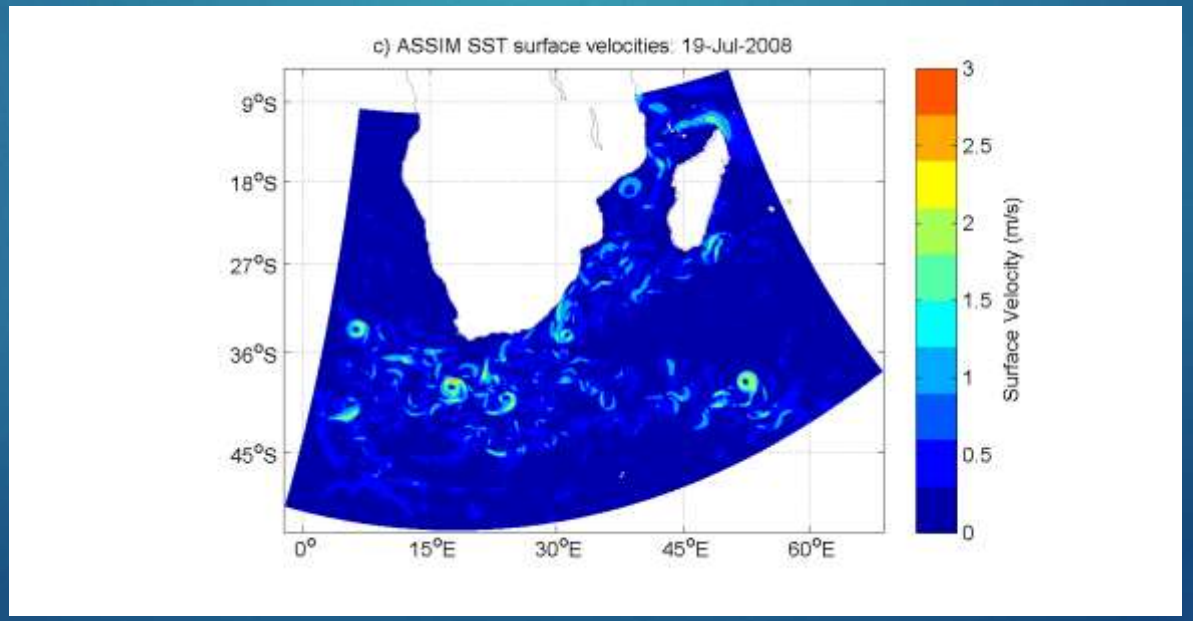
Methods

- HYCOM version 2.2
- EnOI assimilation scheme
- Along-track altimetry and satellite SST assimilated every 7 days
- OSTIA SST and Ssalto/Duacs produced altimetry
- Drifters and Argo floats utilised to evaluate assimilation

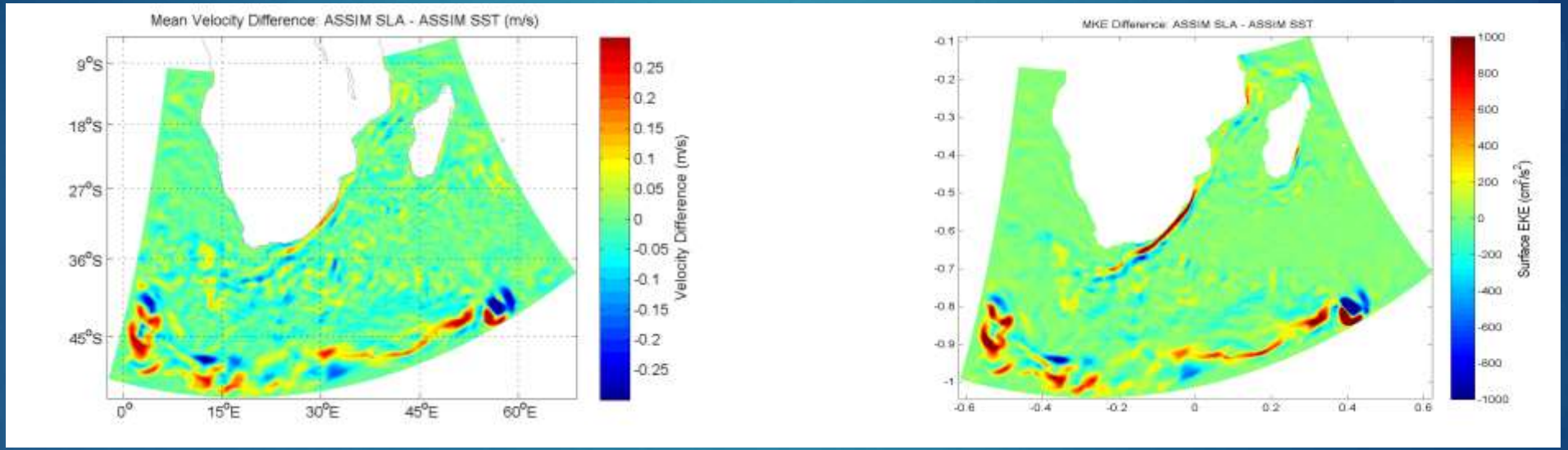
Results

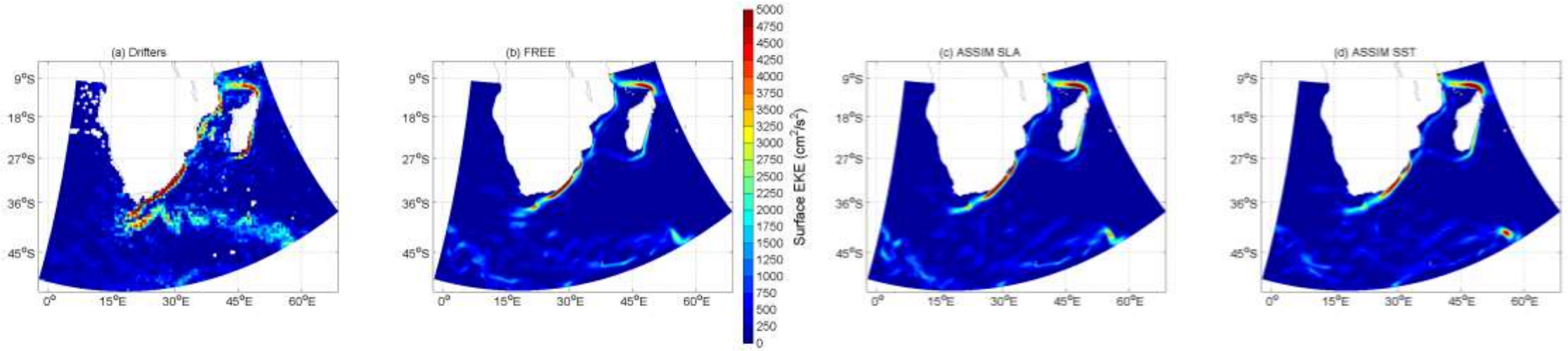

ASSIM SST: R=0.45318, RMSE=0.52063
ASSIM SLA: R=0.38797, RMSE=0.43937
FREE: R=0.19155, RMSE=0.5359
AVISO: R=0.61636, RMSE=0.30914
Drifter #71114
Daily mean velocity magnitude (m/s)
Jan 08
Feb 08
Mar 08
Apr 08
May 08
Jun 08
Jul 08
28°S
32°S
36°S
40°S
44°S
15°E
20°E
25°E
30°E
35°E

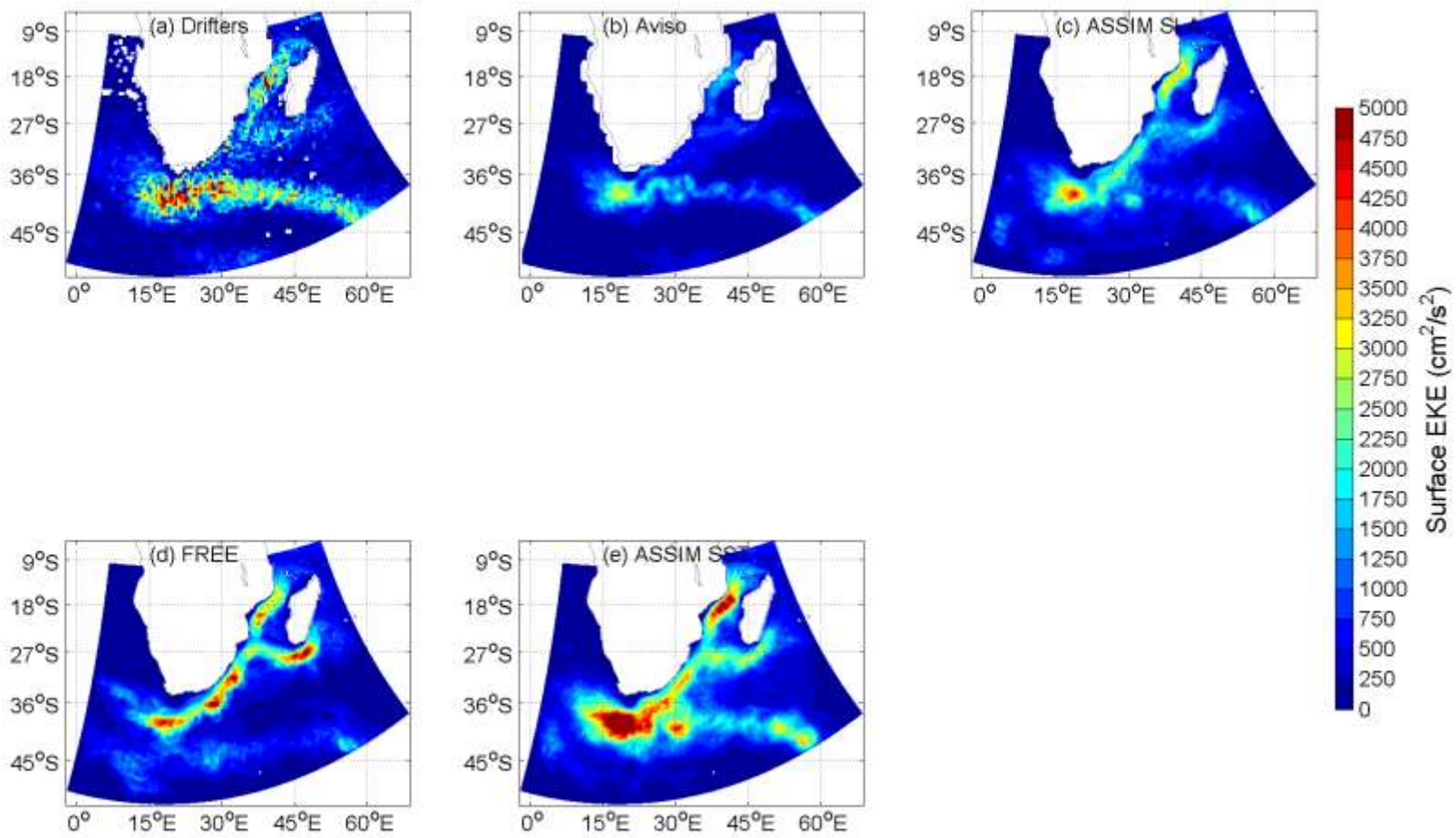

a) FREE surface velocities: 19-Jul-2008
b) ASSIM SLA surface velocities: 19-Jul-2008
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
Surface Velocity (m/s)
0
0.5
1
1.5
2
2.5
3


c) ASSIM SST surface velocities: 19-Jul-2008
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
Surface Velocity (m/s)
0
0.5
1
1.5
2
2.5
3

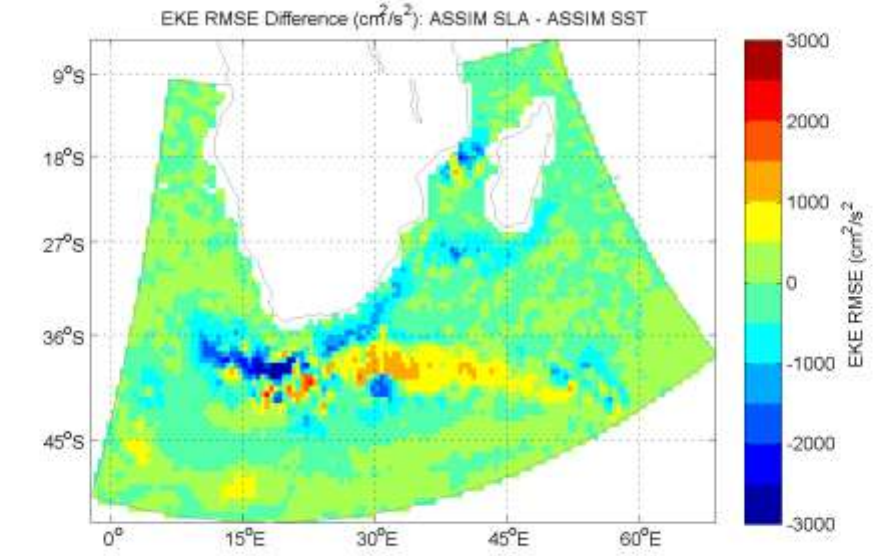
	FREE	ASSIM SLA	ASSIM SST	AVISO
$R_{u \& v \text{ comp.}}$	0.07	0.33	0.35	0.91
$RMSE_{vel. mag.}$	0.31	0.26	0.30	0.18

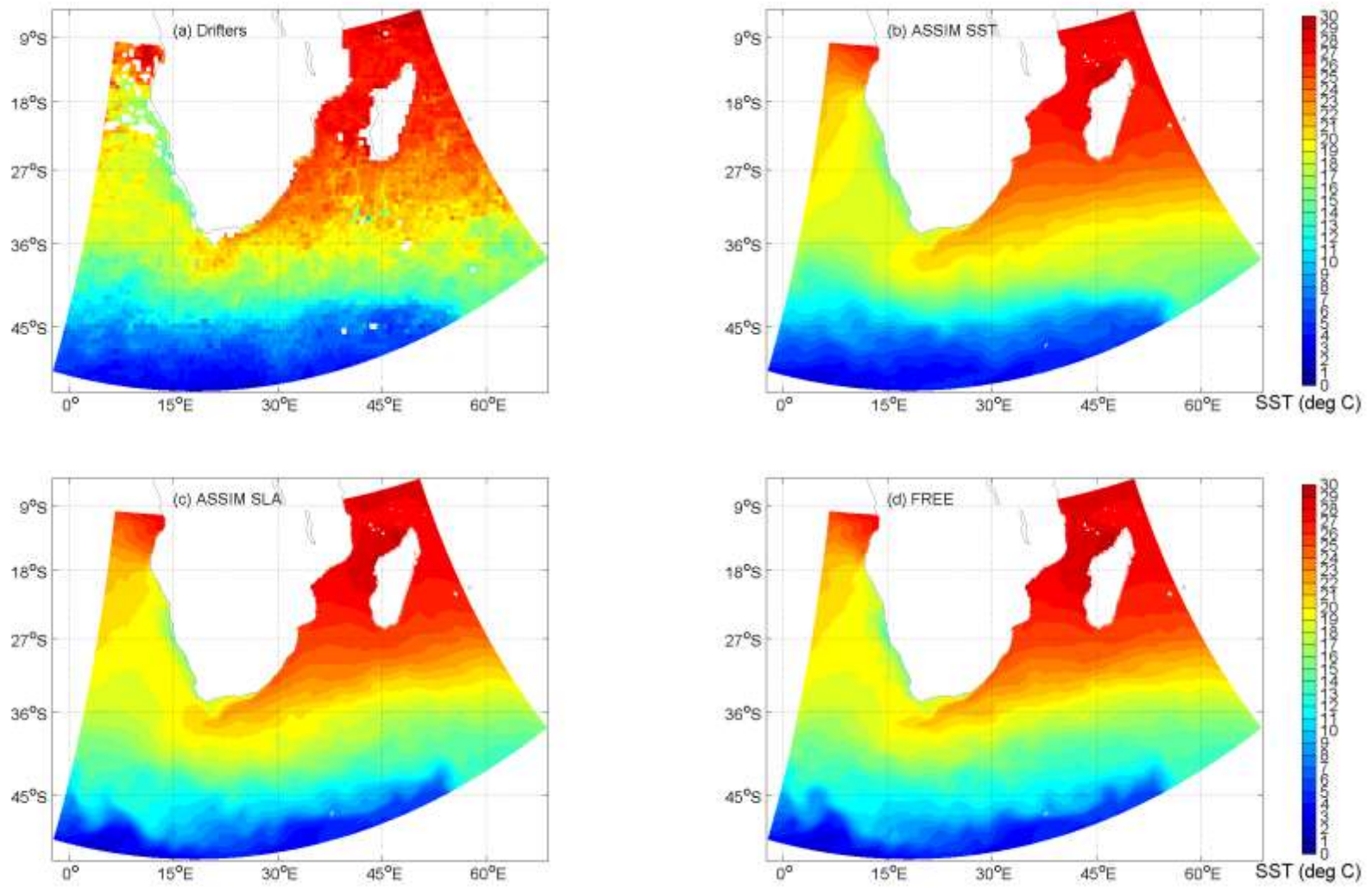


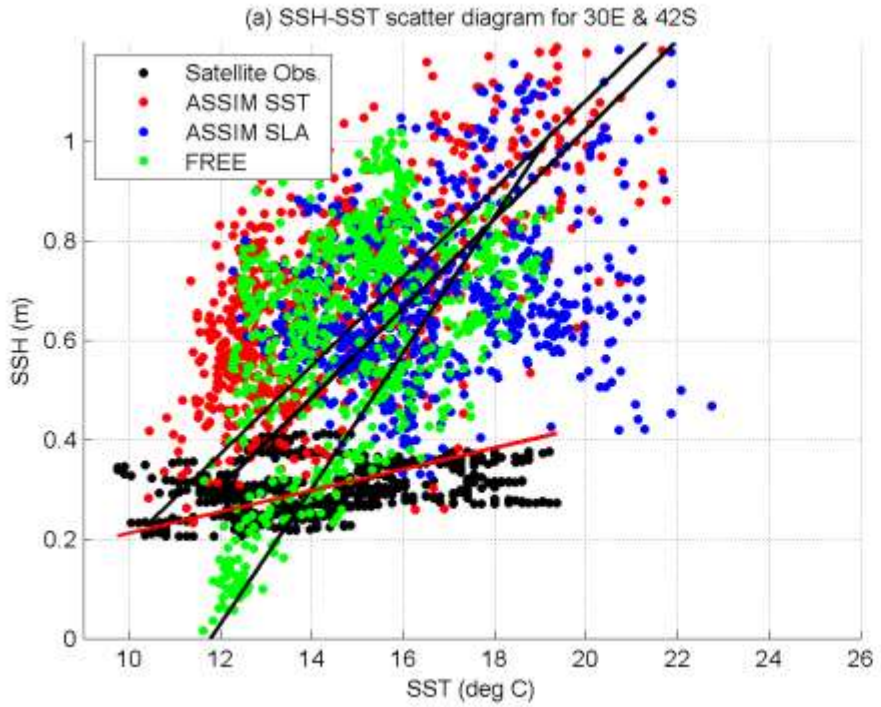

(a) Drifters
(b) FREE
(c) ASSIM SLA
(d) ASSIM SST
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
Surface EKE (cm²/s²)
5000
4750
4500
4250
4000
3750
3500
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0

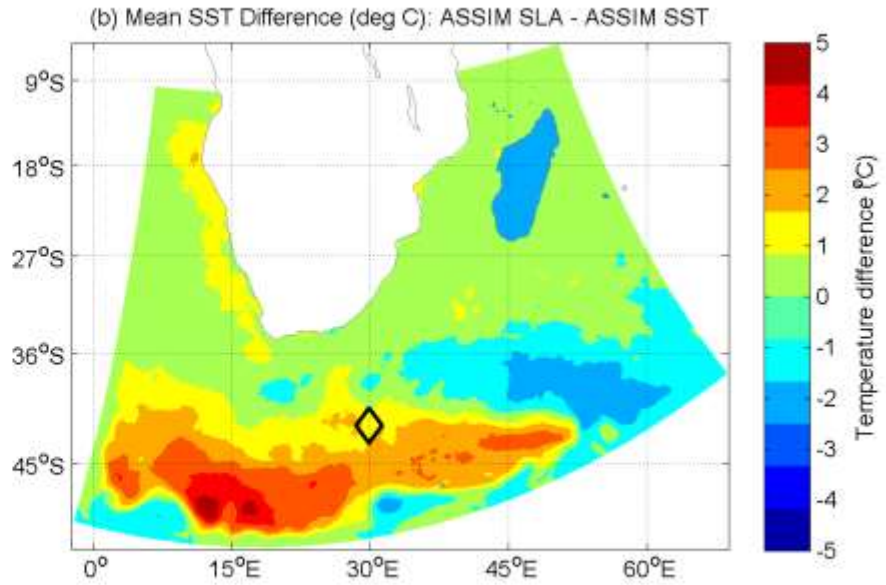

(a) Drifters
(b) Aviso
(c) ASSIM S
(d) FREE
(e) ASSIM S
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
5000
4750
4500
4250
4000
3750
3500
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
Surface EKE (cm²/s²)

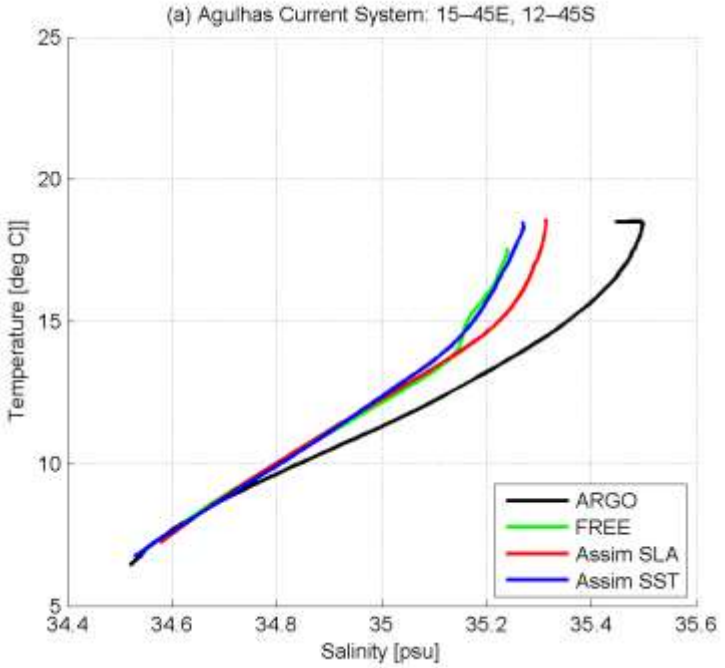
FREE	ASSIM SLA	ASSIM SST	AVISO
845.62	621.78	742.34	694.79

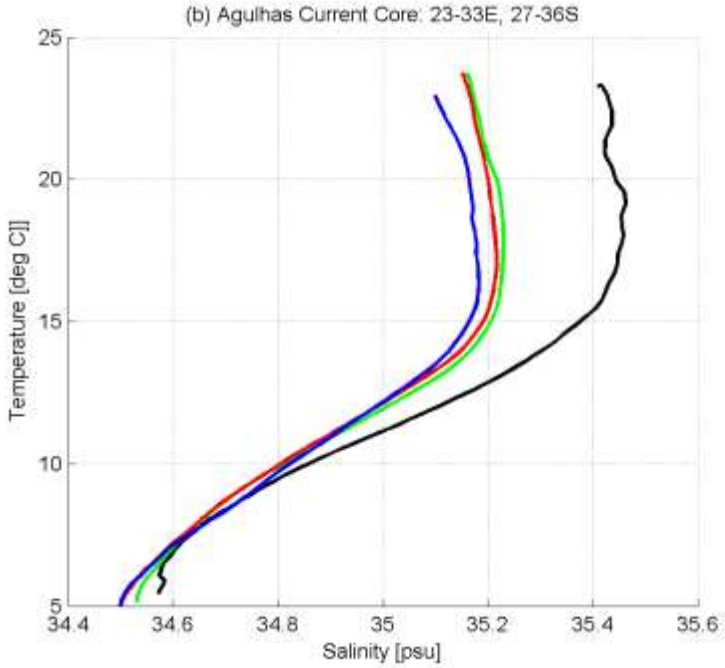


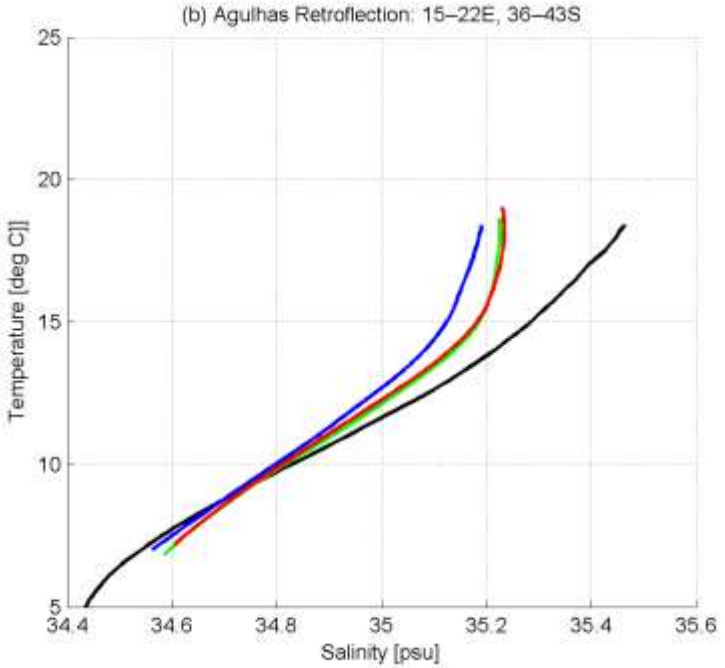

(a) Drifters
(b) ASSIM SST
(c) ASSIM SLA
(d) FREE
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
SST (deg C)

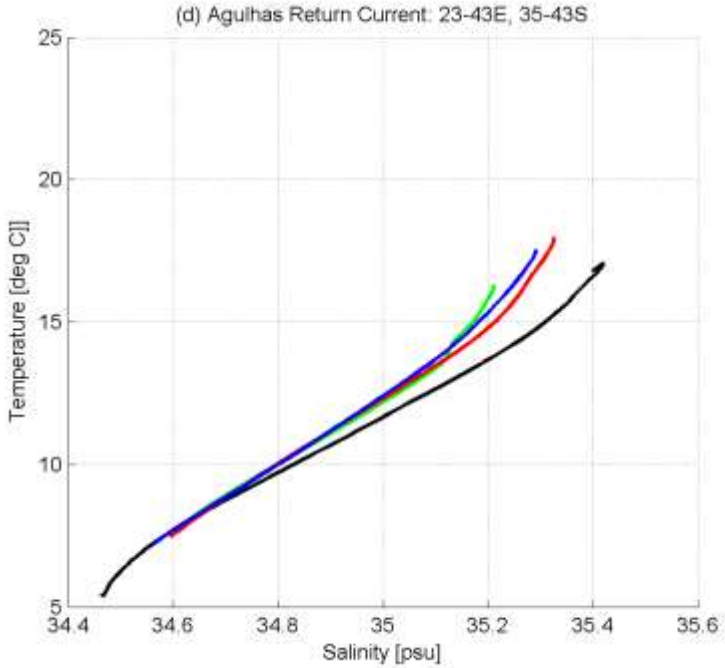

(a) SSH-SST scatter diagram for 30E & 42S
Satellite Obs.
ASSIM SST
ASSIM SLA
FREE
SSH (m)
SST (deg C)
0
0.2
0.4
0.6
0.8
1
10
12
14
16
18
20
22
24
26

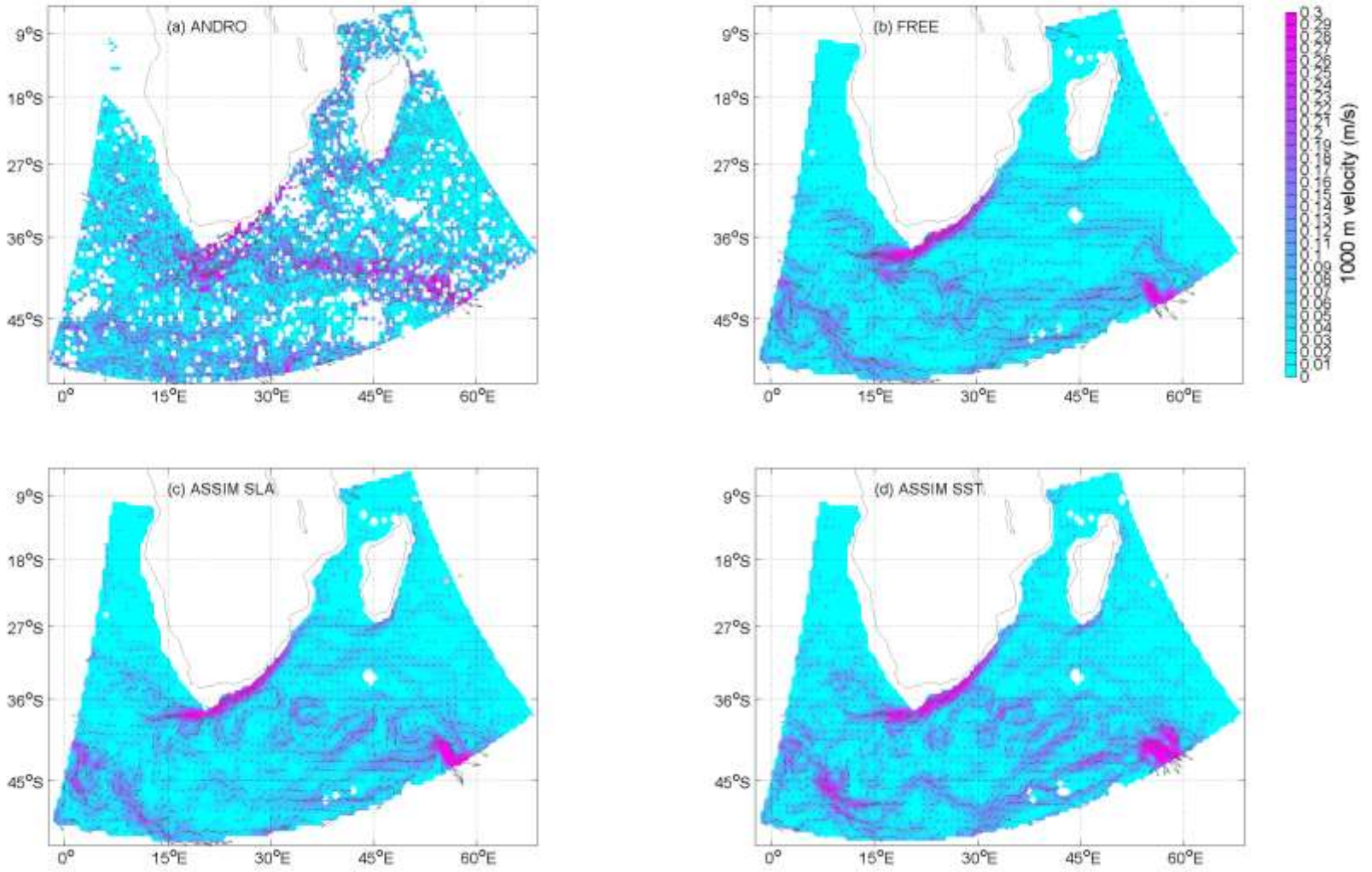

(b) Mean SST Difference (deg C): ASSIM SLA - ASSIM SST
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
Temperature difference (°C)
5
4
3
2
1
0
-1
-2
-3
-4
-5


(a) Agulhas Current System: 15–45E, 12–45S
Temperature [deg C]
Salinity [psu]
ARGO
FREE
Assim SLA
Assim SST


(b) Agulhas Current Core: 23-33E, 27-36S
Temperature [deg C]
Salinity [psu]


(b) Agulhas Retroflection: 15–22E, 36–43S
Temperature [deg C]
Salinity [psu]


(d) Agulhas Return Current: 23-43E, 35-43S
Temperature [deg C]
Salinity [psu]


(a) ANDRO
(b) FREE
(c) ASSIM SLA
(d) ASSIM SST
9°S
18°S
27°S
36°S
45°S
0°
15°E
30°E
45°E
60°E
1000 m velocity (m/s)

	FREE	ASSIM SLA	ASSIM SST	AVISO
$R_{drifter\ u\ \&\ v\ comp.}$	0.07	0.33	0.35	0.91
$RMSE_{drifter\ vel.\ mag}$ (m/s)	0.31	0.26	0.30	0.18
$RMSE_{drifter\ EKE}$ (cm^2/s^2)	845.62	621.78	742.34	694.79
$RMSE_{drifter\ SST}$ (°C)	1.7	1.9	1.2	
$R_{ANDRO\ u\ \&\ v\ comp.}$	0.18	0.20	0.17	
$RMSE_{ANDRO\ vel.\ mag.}$ (m/s)	0.065	0.061	0.0621	

Conclusion

- Positives and negatives
- Assimilation has its limitations
- The dynamics in the free model must be improved
- In the future look at the covariance between SST and SSH
- Utilise 4^{th} order advection scheme when it is operational
- Increase the frequency of assimilation