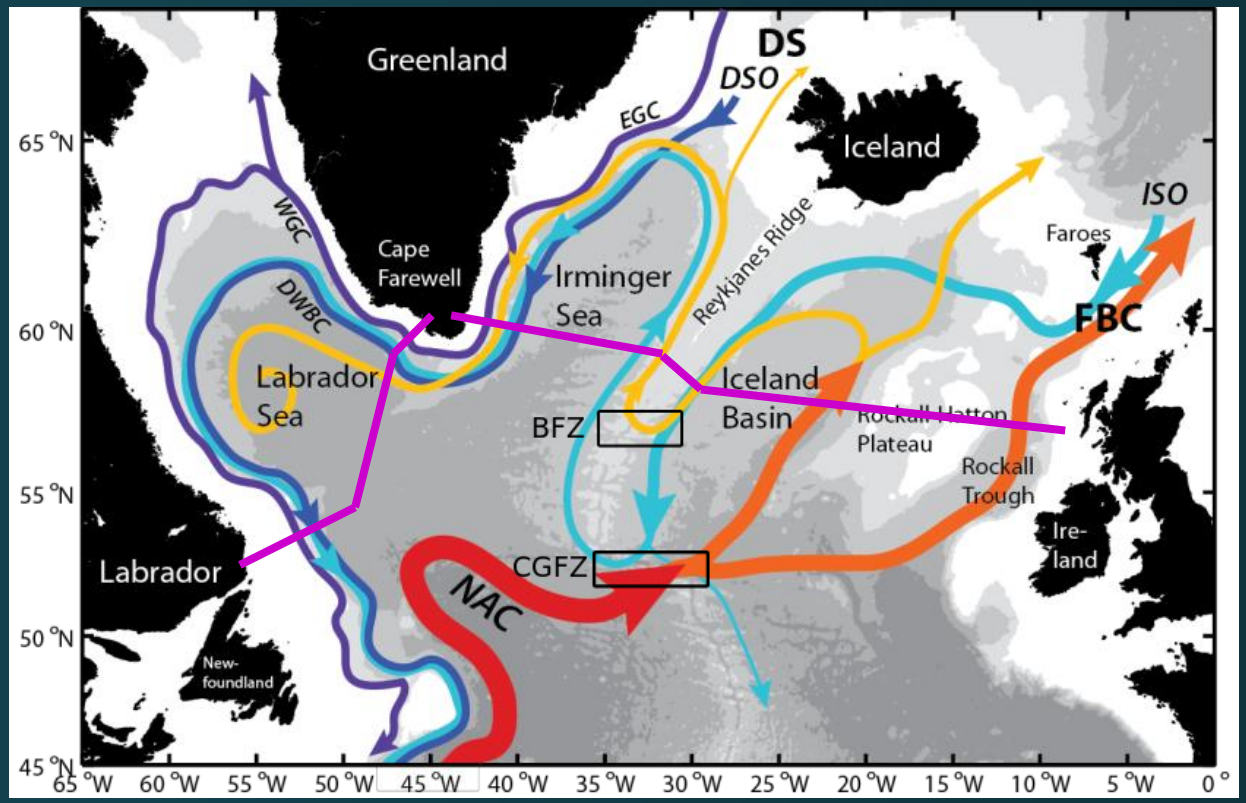
Transport and Energetics of the North Atlantic Current in the Eastern part of the Subpolar Gyre

L. Houpert[a] , M. Inall[a], E. Dumont[a], W. Johns[b], S. Gary[a], M. Porter[a], K. Wilson[a], S. Cunningham[a]

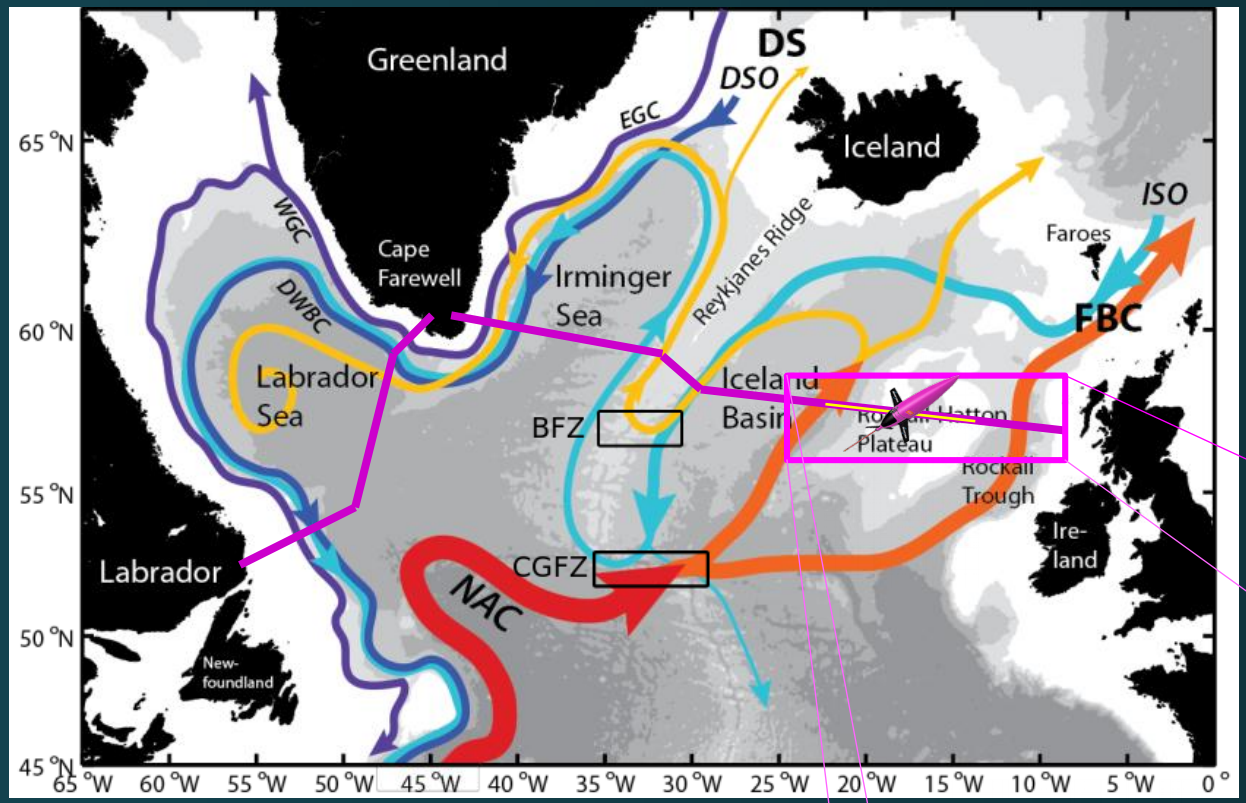
a: Scottish Association for Marine Science, Oban, UK
b: Rosenstiel School of Marine and Atmospheric Science, Miami, US

Overturning in the Subpolar North Atlantic Programme



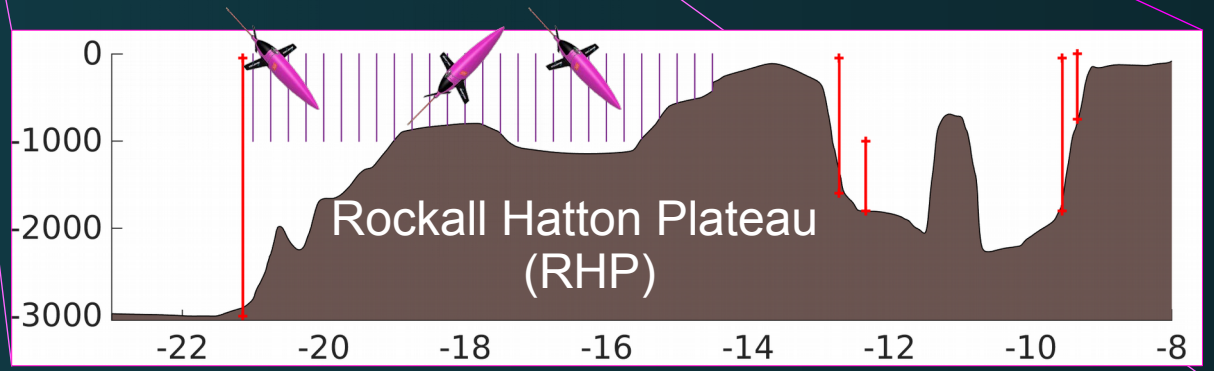
OSNAP objectives
- long term observations (2014-18) of heat, salt and mass fluxes in the subpolar gyre
- quantify the AMOC in the subpolar gyre and its variabiliy (from seasonal to interannual)
- understand the link of the AMOC variability with the variability of the deep water formation and the variability of the wind forcing

Overturning in the Subpolar North Atlantic Programme



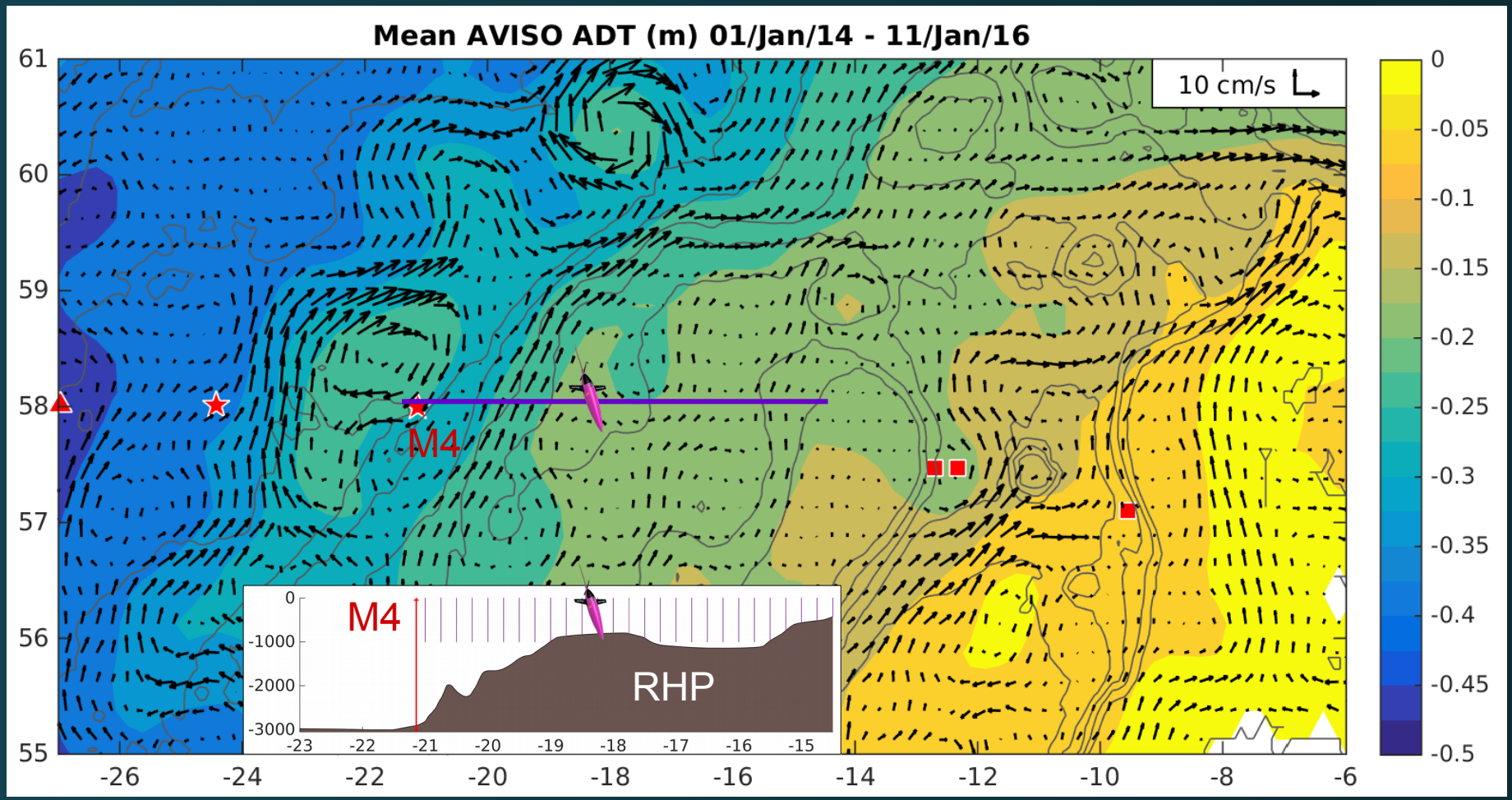
OSNAP objectives
- long term observations (2014-18) of heat, salt and mass fluxes in the subpolar gyre
- quantify the AMOC in the subpolar gyre and its variabiliy (from seasonal to interannual)
- understand the link of the AMOC variability with the variability of the deep water formation and the variability of the wind forcing

Eastern boundary array goals:
- quantify northward-flowing flux on Rockall Plateau and Trough
- determine the magnitude and variability of the cold overflow across the Wyville-Thomson Ridge.



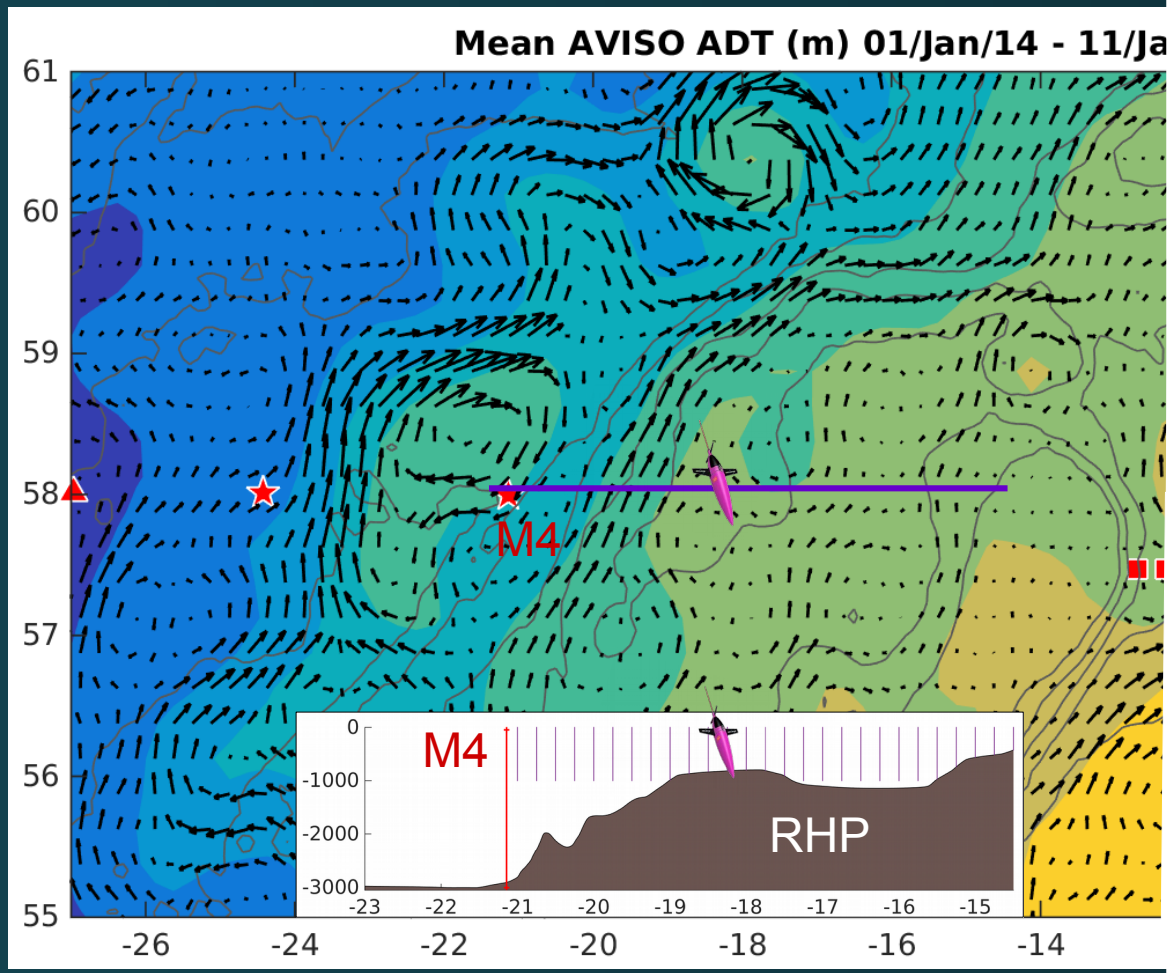
Circulation from surface altimetry

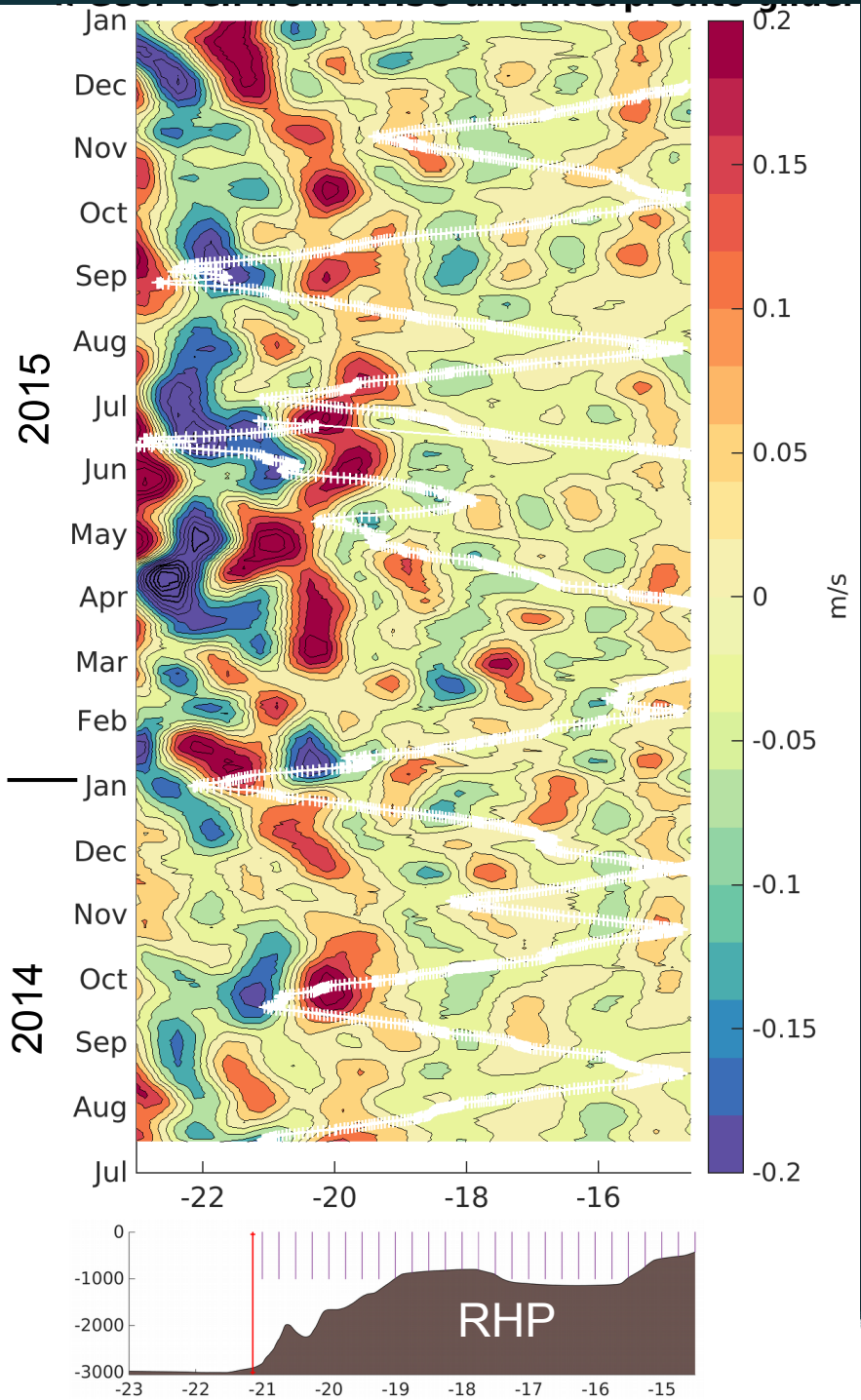
Why glider on the Rockall Hatton Plateau ?
- uncertainty on the net circulation on RHP
- initially planned to estimate relative geostrophic transport from mooring M4 and glider profiles



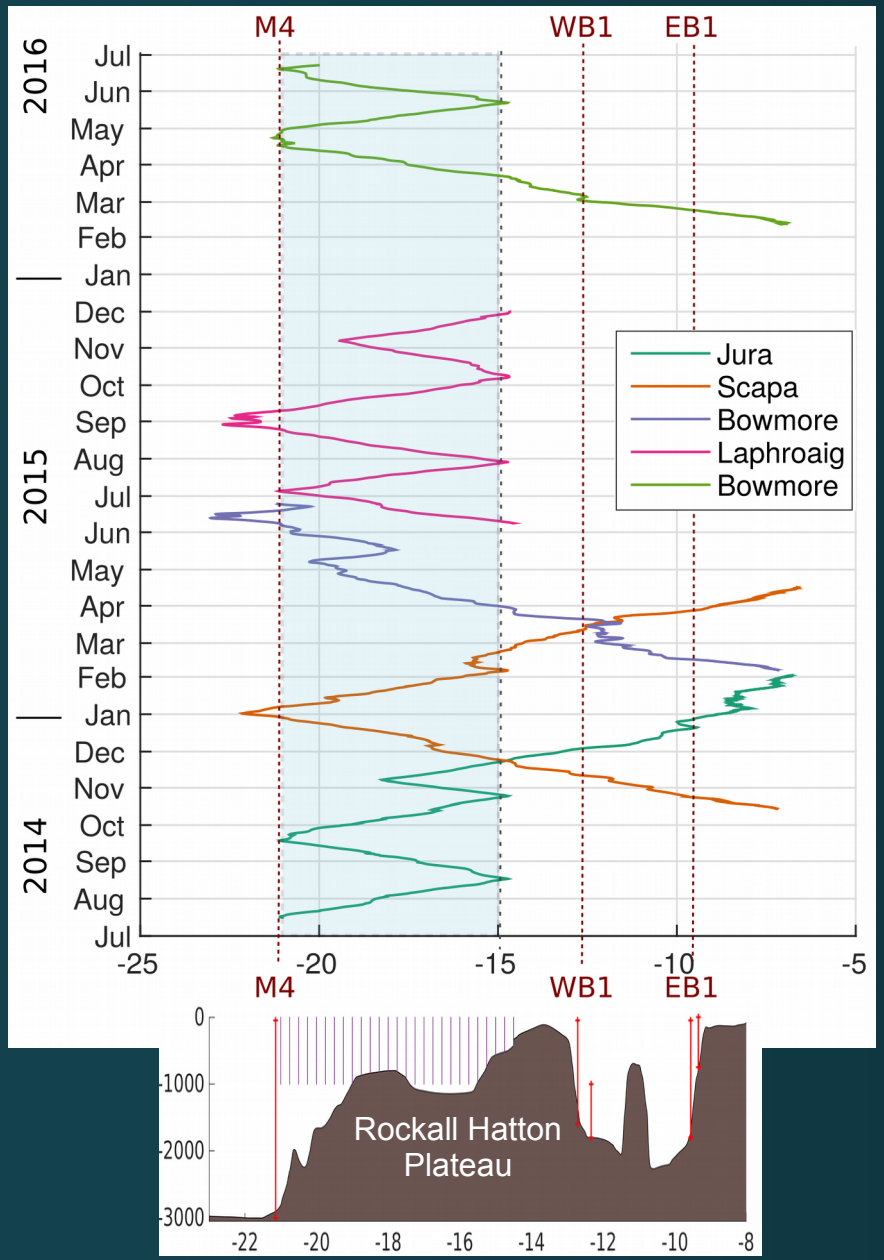
Circulation from surface altimetry

Why glider on the Rockall Hatton Plateau ?
- uncertainty on the net circulation on RHP
- initially planned to estimate relative geostrophic transport from mooring M4 and glider profiles



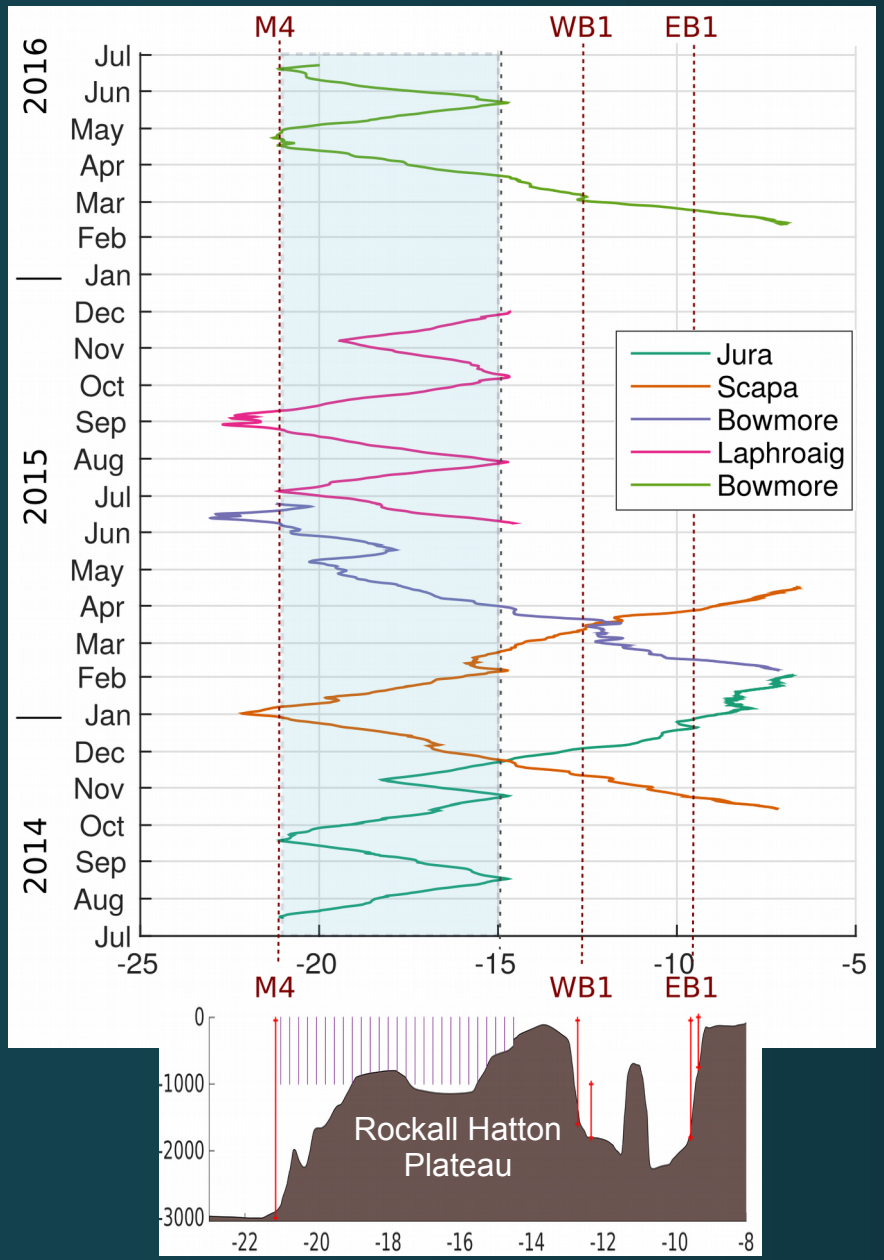


The UK-OSNAP glider programme



→ Aim : Permanent monthly occupation of RHP for the duration of OSNAP (2014-18)
July 2014/16: 15 sections (5000 profiles)

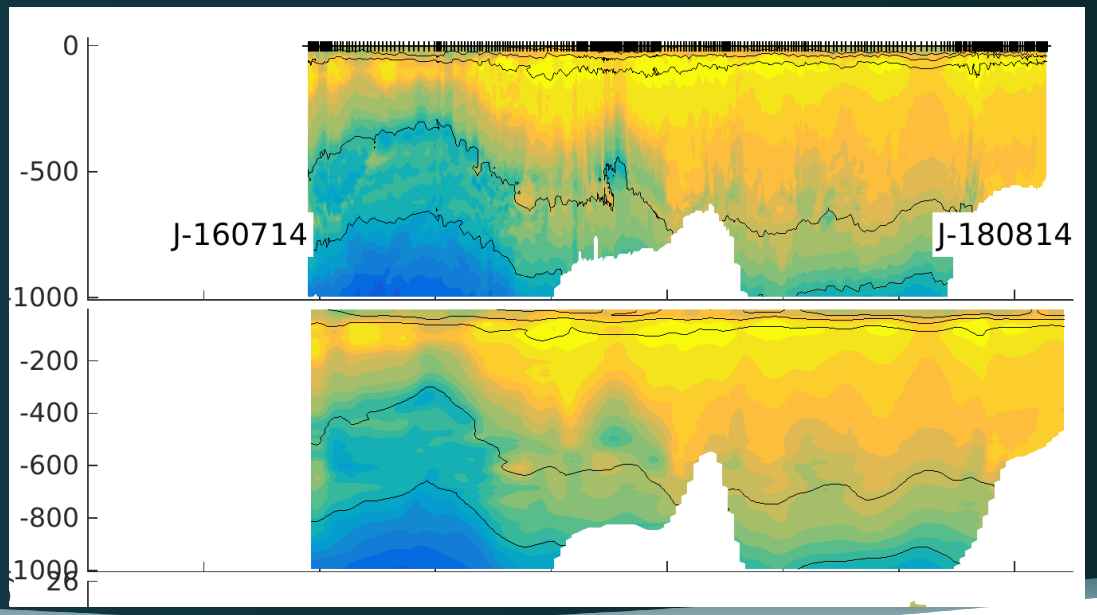
The UK-OSNAP glider programme



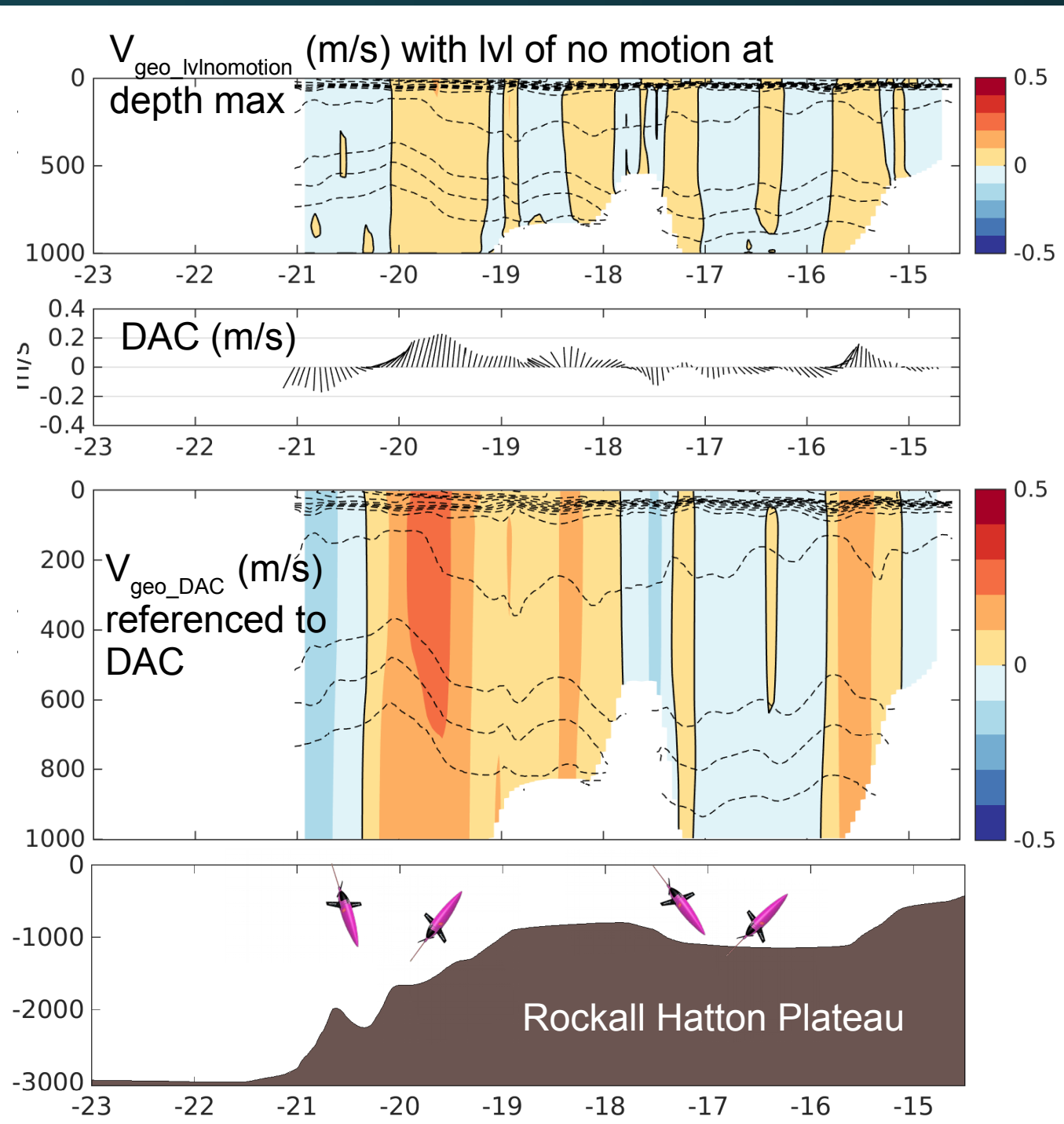
→ Aim : Permanent monthly occupation of RHP for the duration of OSNAP (2014-18)
July 2014/16: 15 sections (5000 profiles)

- Data quality control: spikes removed, thermistor lag and thermal-inertia of the conductivity sensor corrections (Seaglider basestation v2.09) ; comparison to climatological data ; manual QC

-Data filtering : objective analysis using Gaussian covariance function with a spatial scale of 20km



Absolute geostrophic velocity from glider

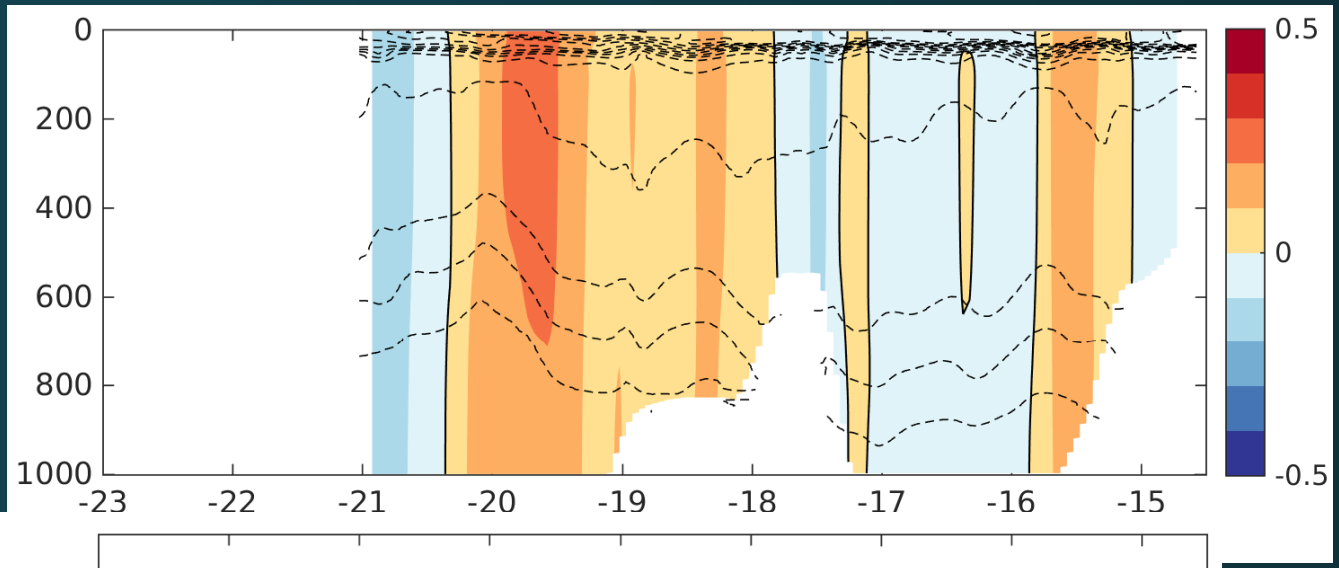


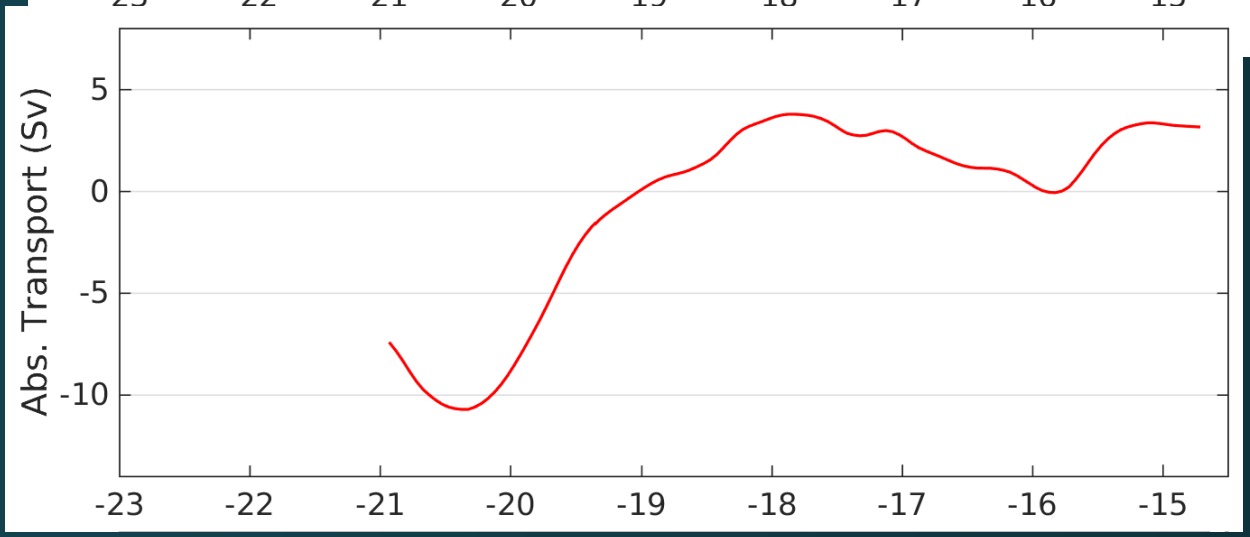
DAC mostly geostrophic
- Ekman contribution to the DAC (depth of the dive ~1000m is larger than the Ekman layer depth by 1 order of magnitude),
- Low tides (max of 5cm/s at 14.5W from 1/12 tide predition model); high frequency varibility filtered using a 48h lowpass hamming filter, before the obj. analysis

Absolute geostrophic velocities are obtained by vertically integrating the thermal wind balance on the smoothed density section and by taking as a reference for the 0-1000m mean velocities the cross-section component of the depth-averaged currents derived from the glider movement.

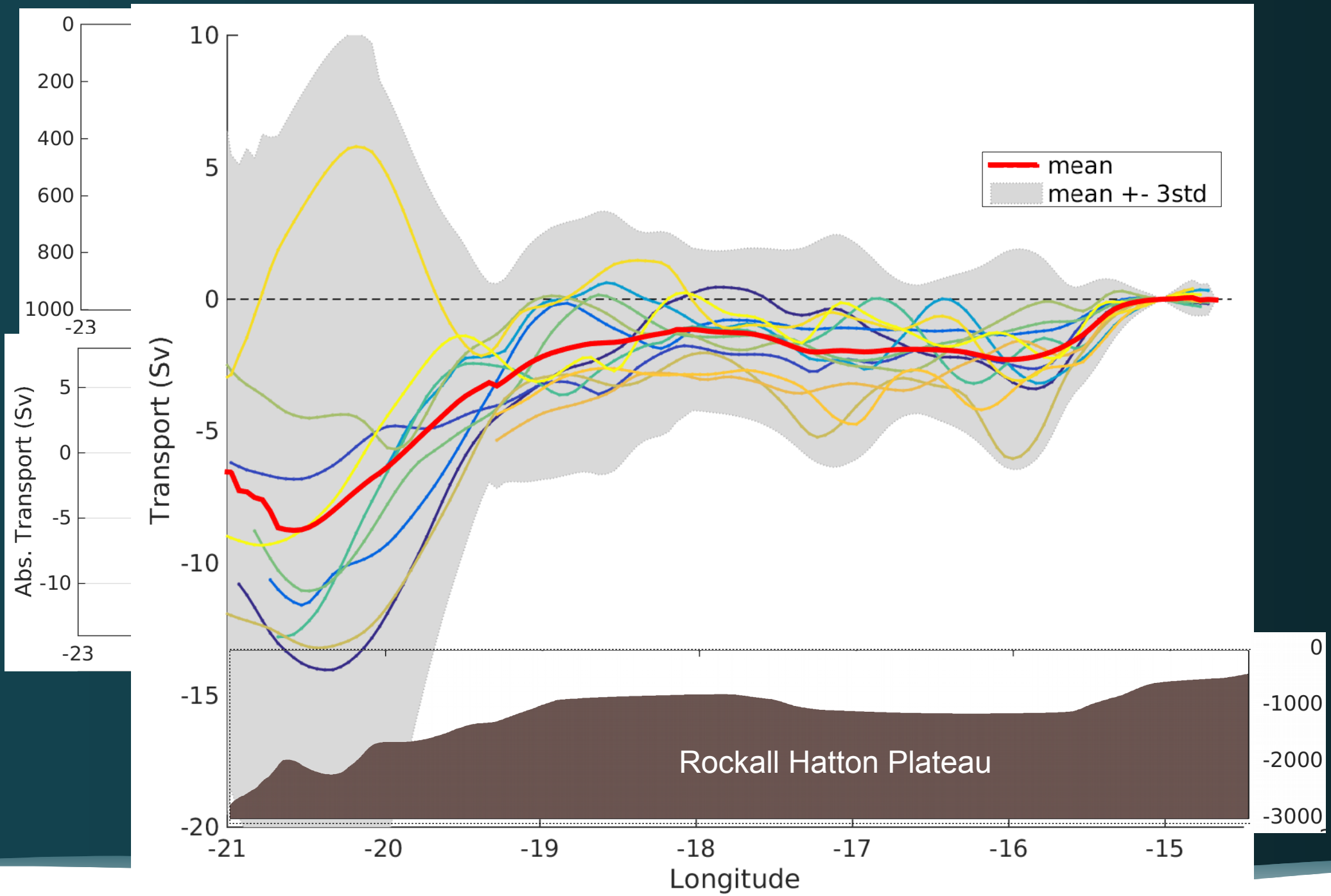
L. Houpert

Absolute transport on Rockall-Hatton Plateau



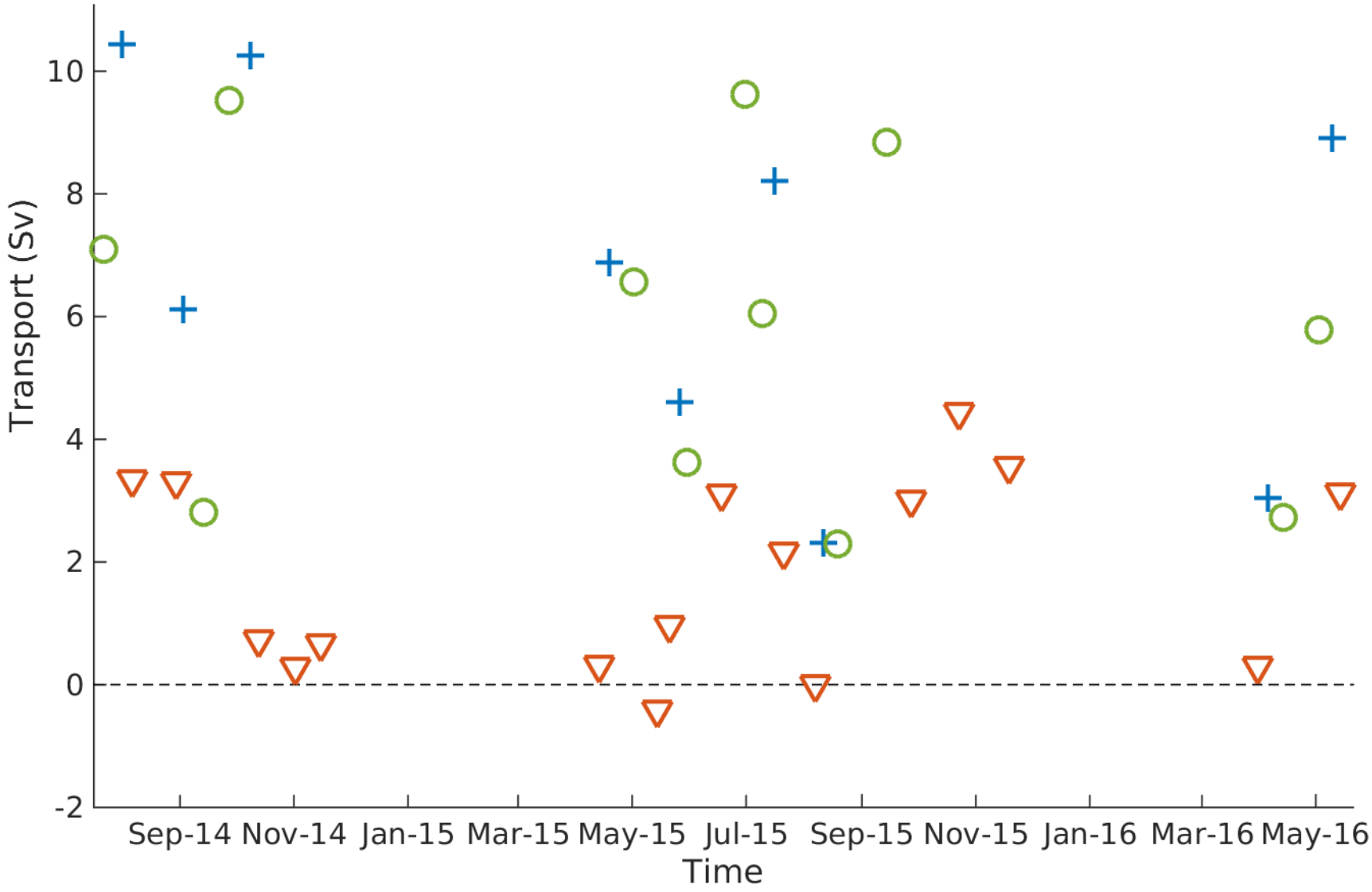


Absolute transport on Rockall-Hatton Plateau

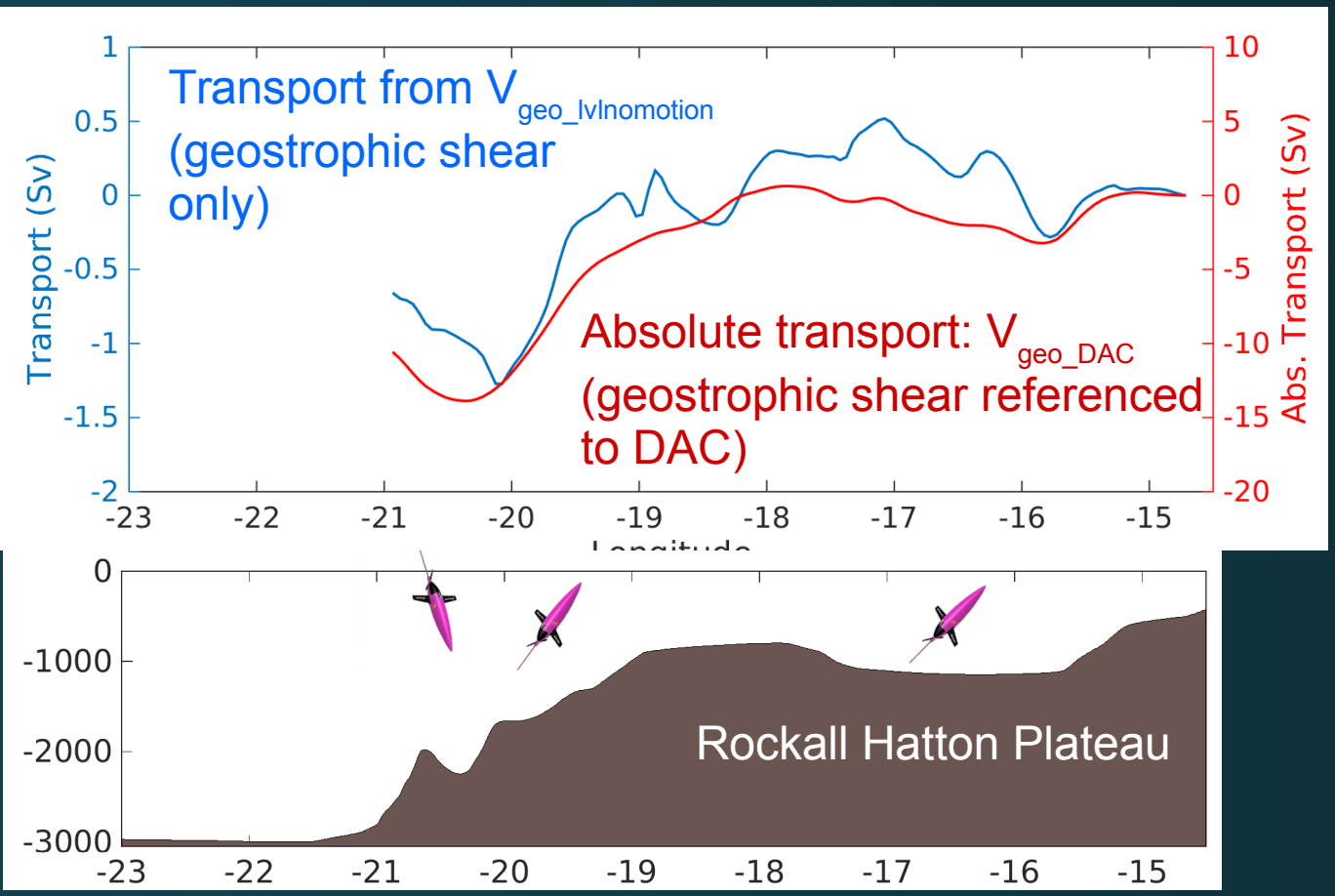


Absolute transport Rockall-Hatton Plateau

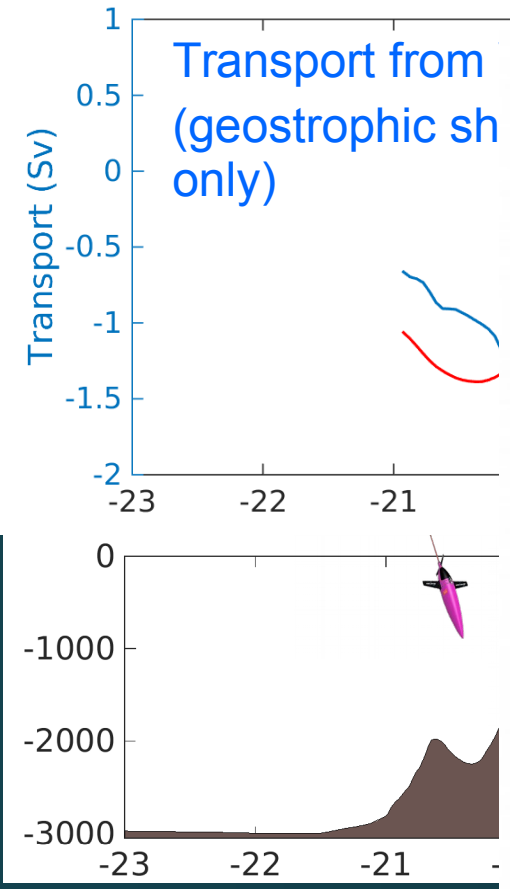
15 sections with absolute transport estimate :
- on Rockall Plateau : 1.8Sv (Std : 1.6Sv)
- in the east of the Iceland Basin (M4 – Rockall Plateau) : 5.9Sv +- 2.7Sv

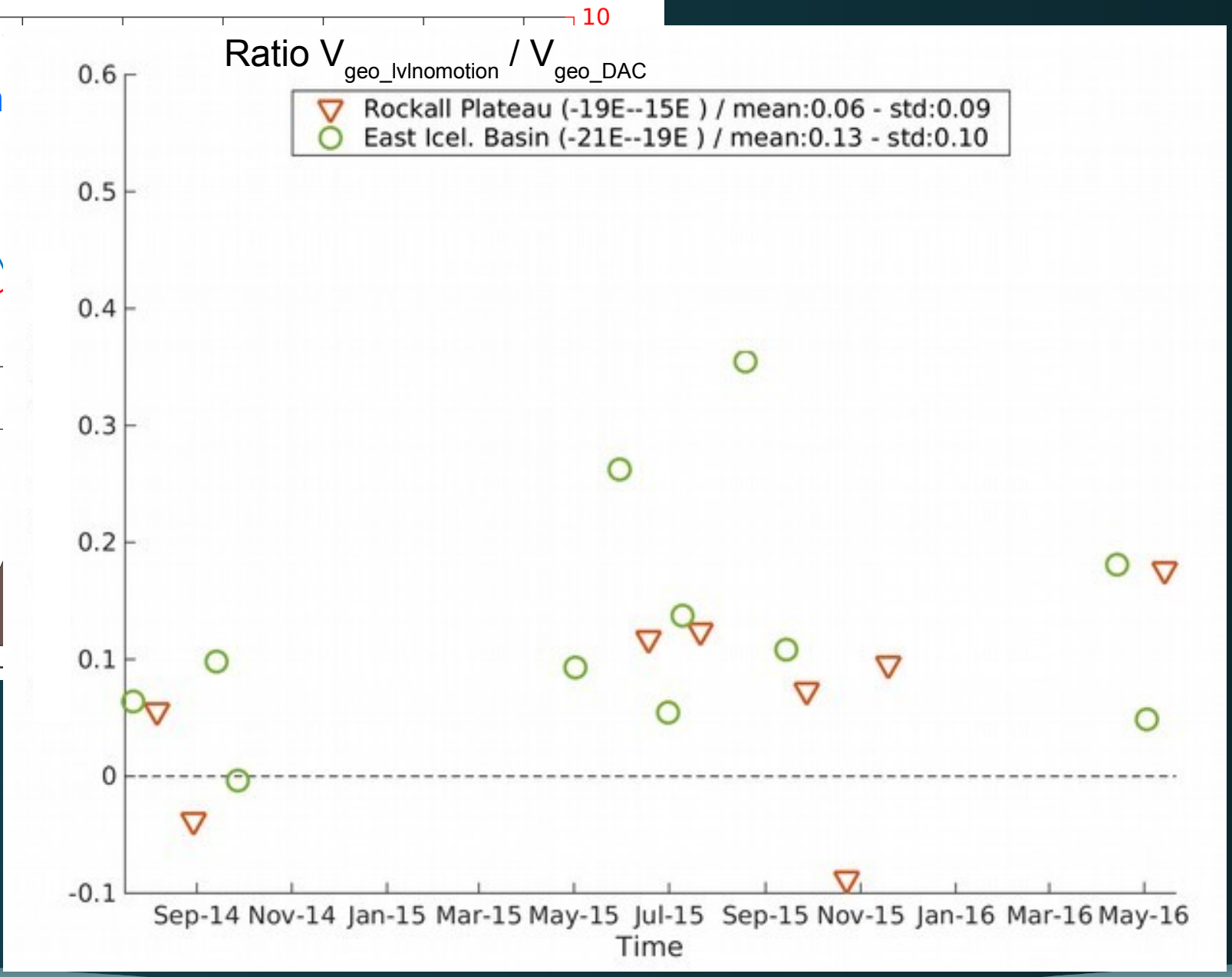


Most of the absolute transport come from the DAC

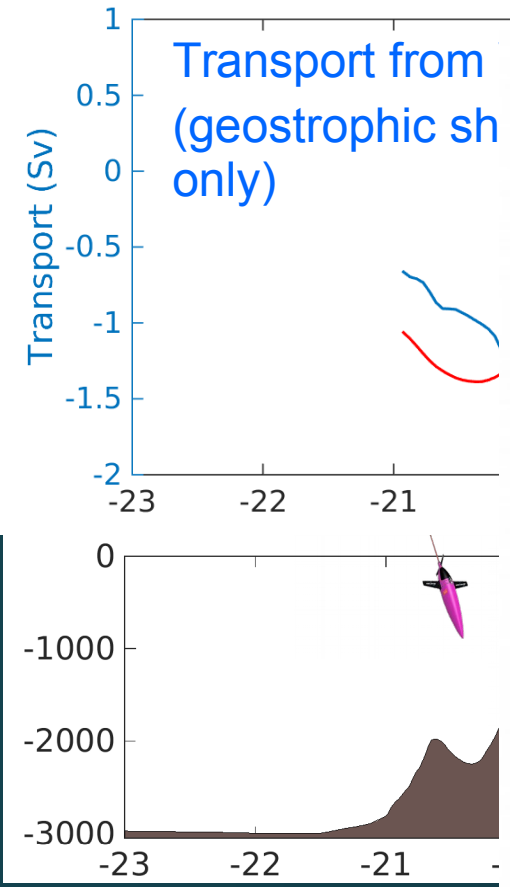


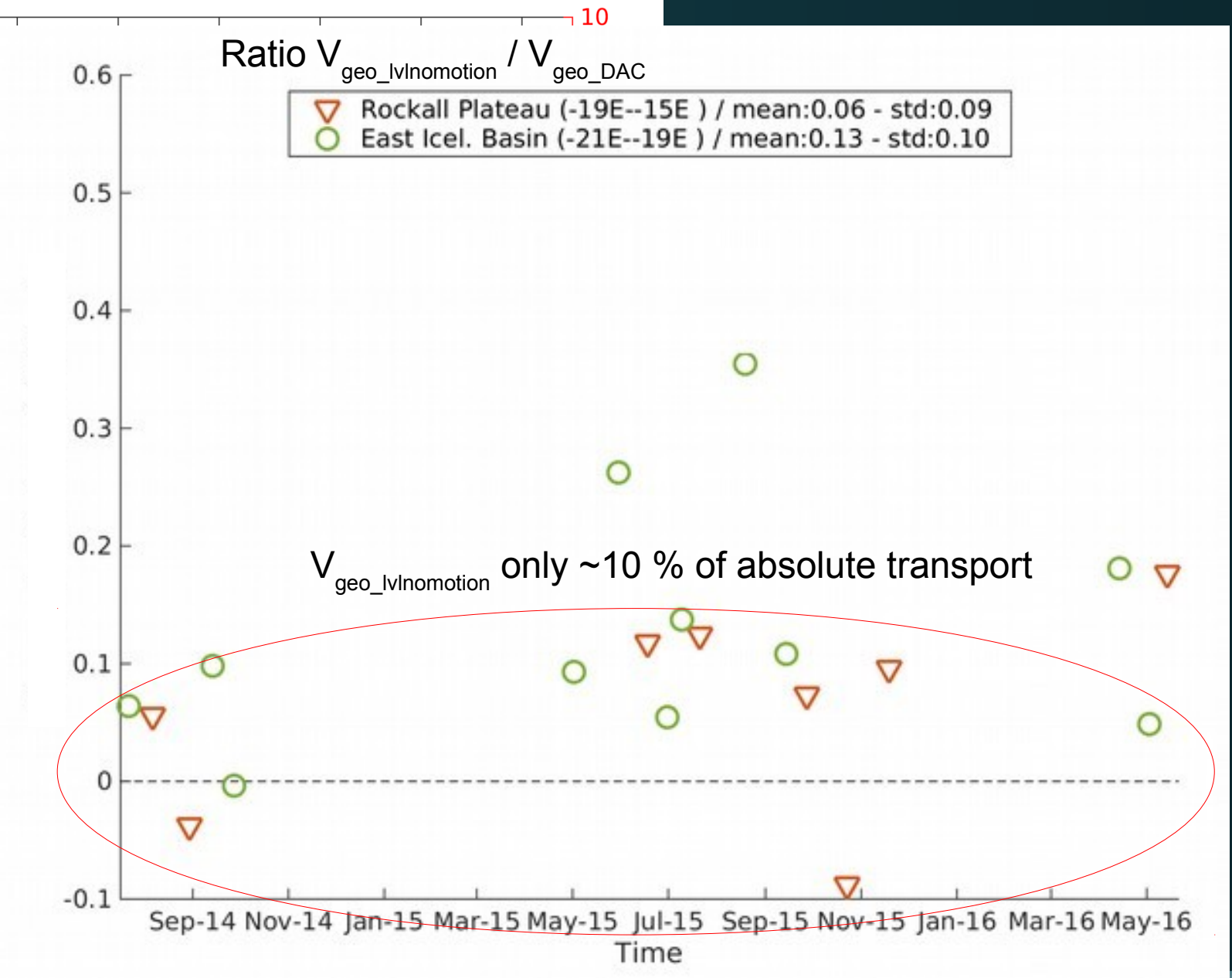
Most of the absolute transport come from the DAC



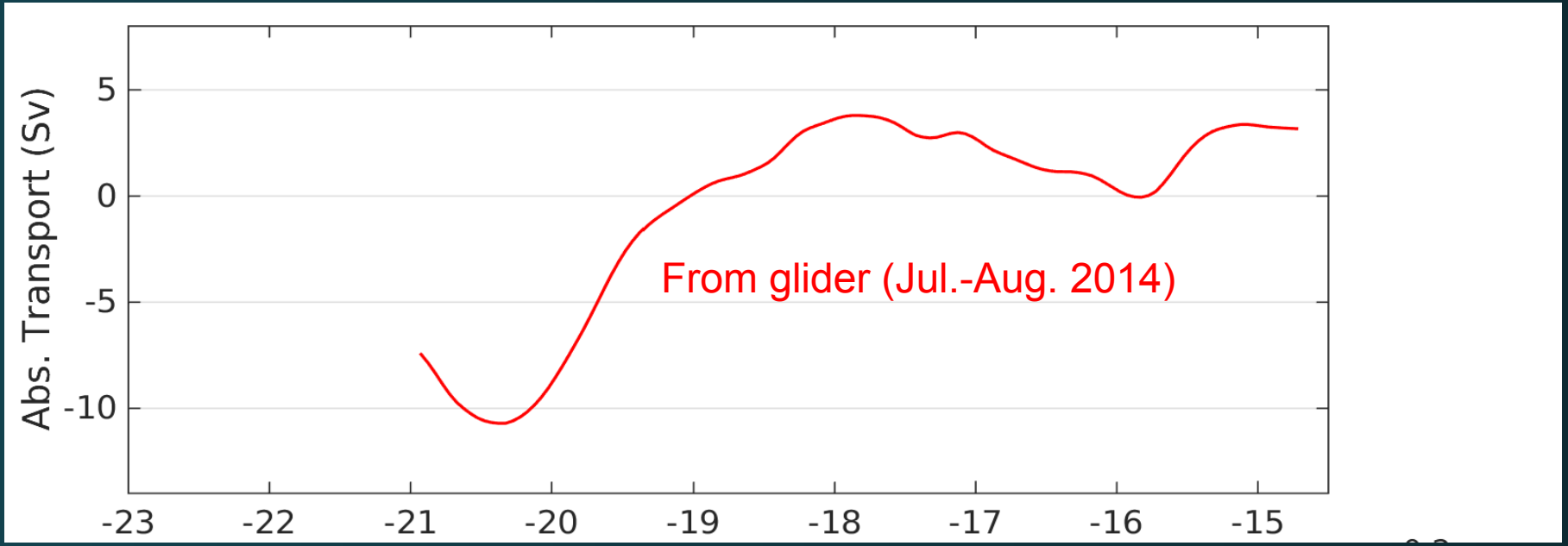


Most of the absolute transport come from the DAC

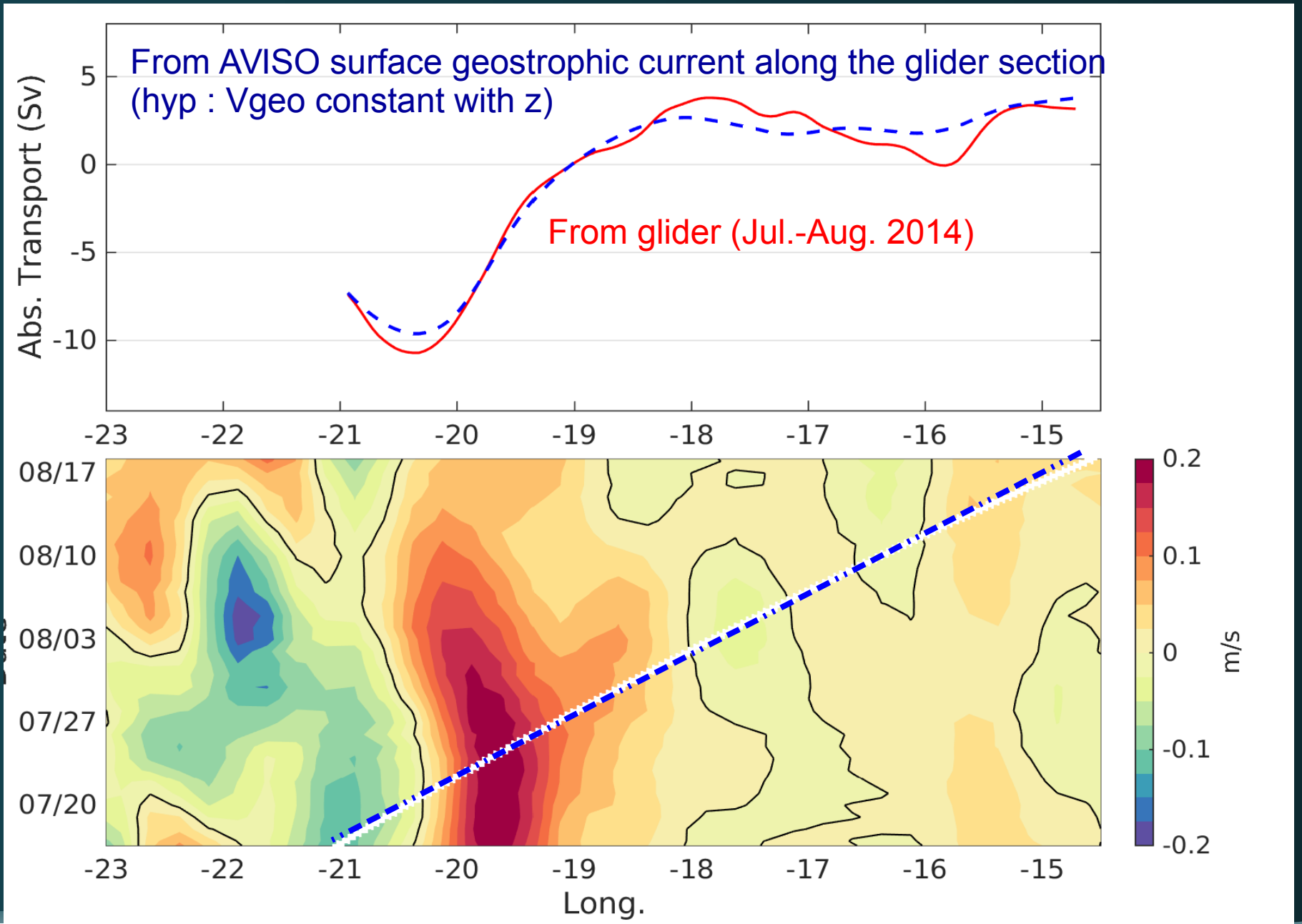




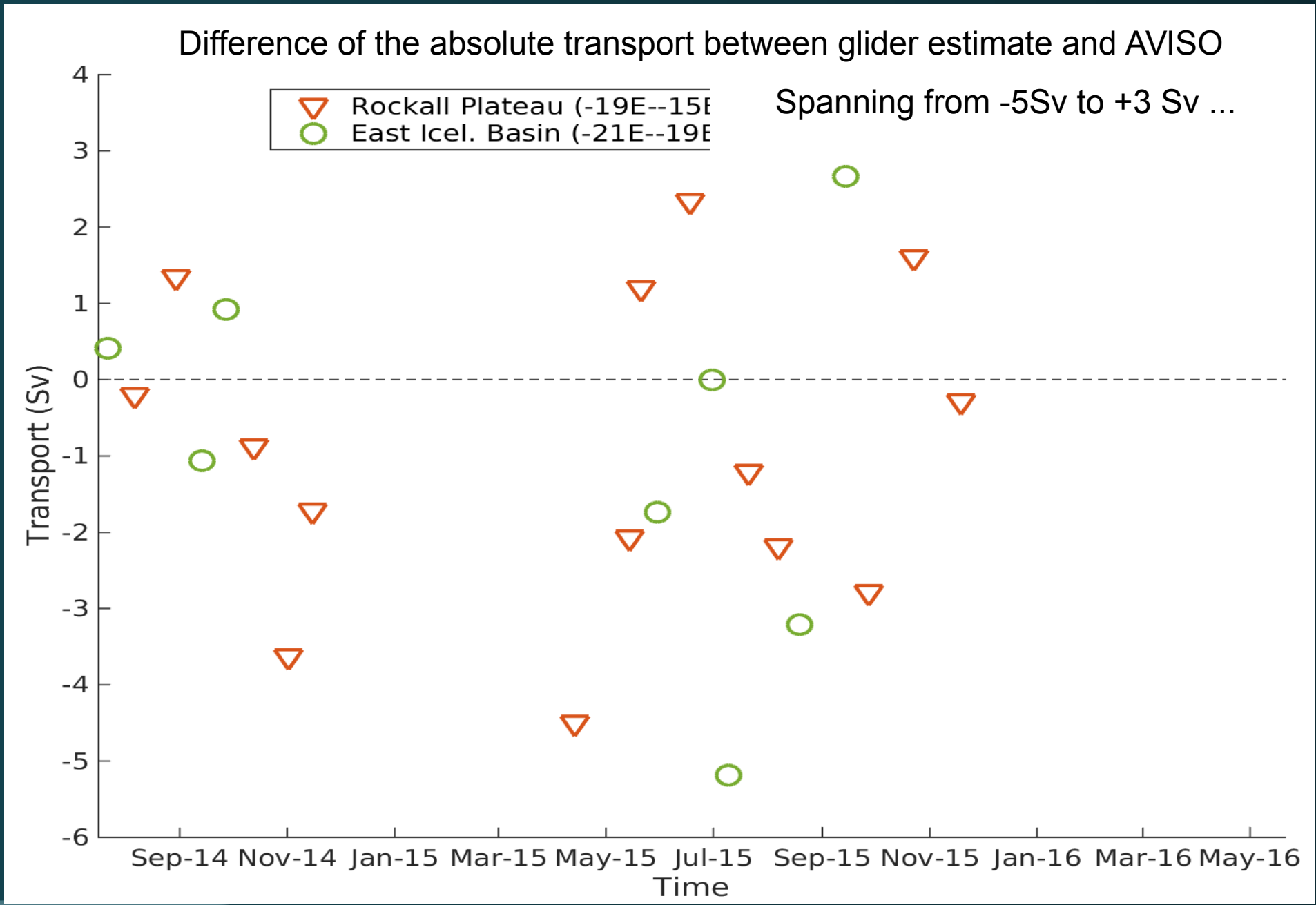
Comparison with AVISO estimate

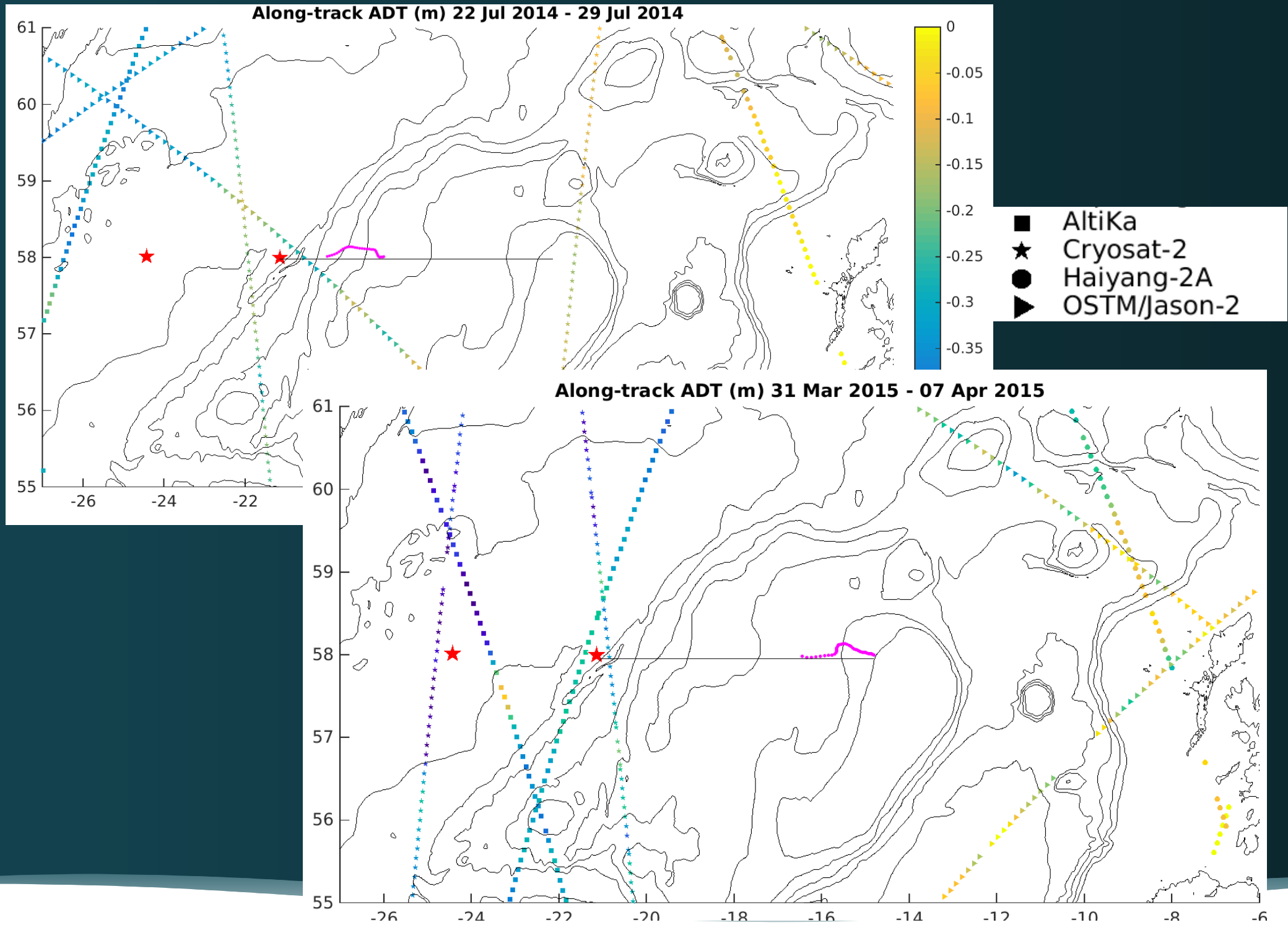


Comparison with AVISO estimate



Comparison with AVISO estimate




Along-track ADT (m) 22 Jul 2014 - 29 Jul 2014
Along-track ADT (m) 31 Mar 2015 - 07 Apr 2015
AltiKa
Cryosat-2
Haiyang-2A
OSTM/Jason-2
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
61
60
59
58
57
56
55
-26
-24
-22
-20
-18
-16
-14
-12
-10
-8
-6

Conclusion

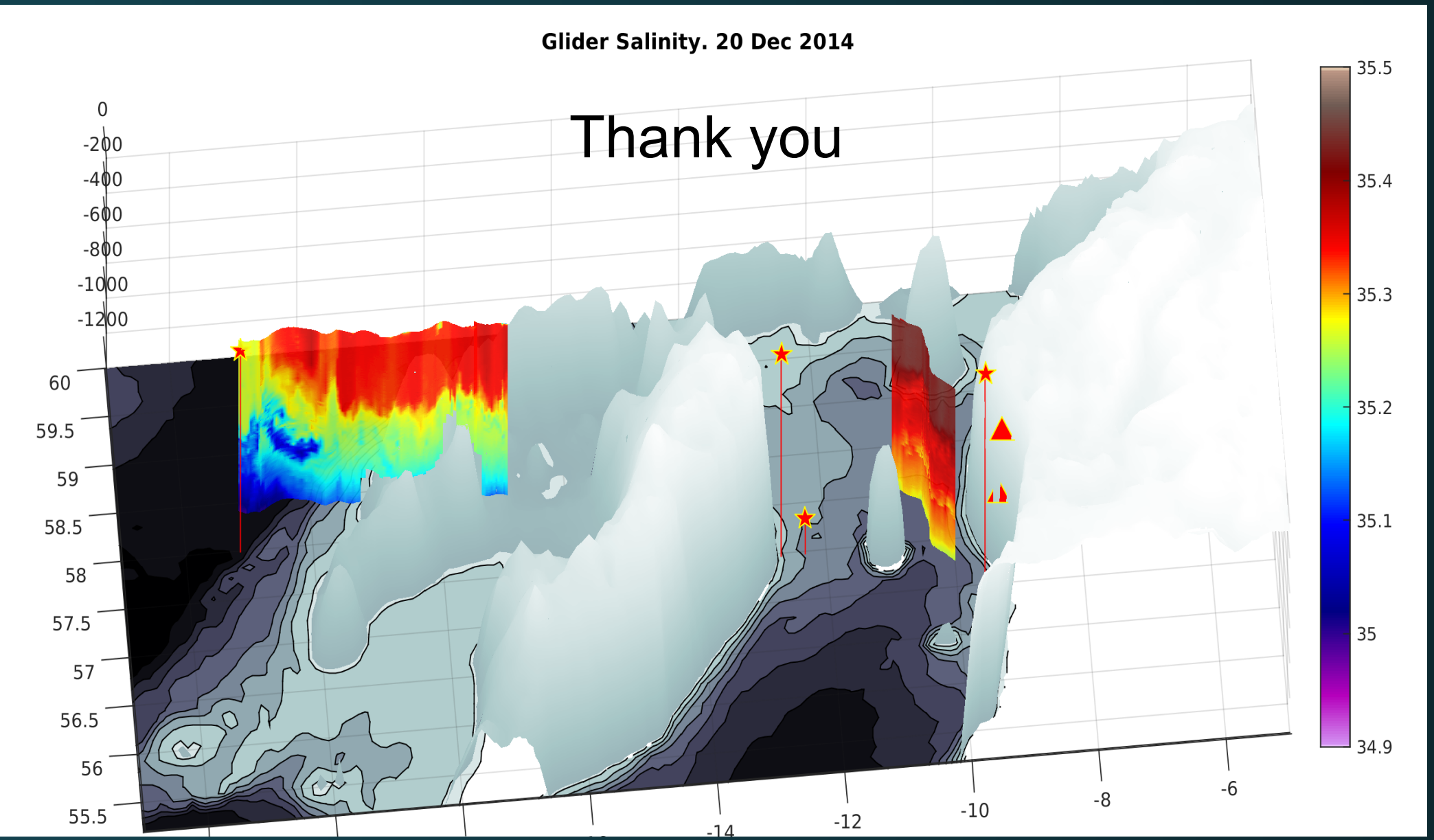
- Absolute transport on RHP: 1.8Sv (std: 1.6 Sv)

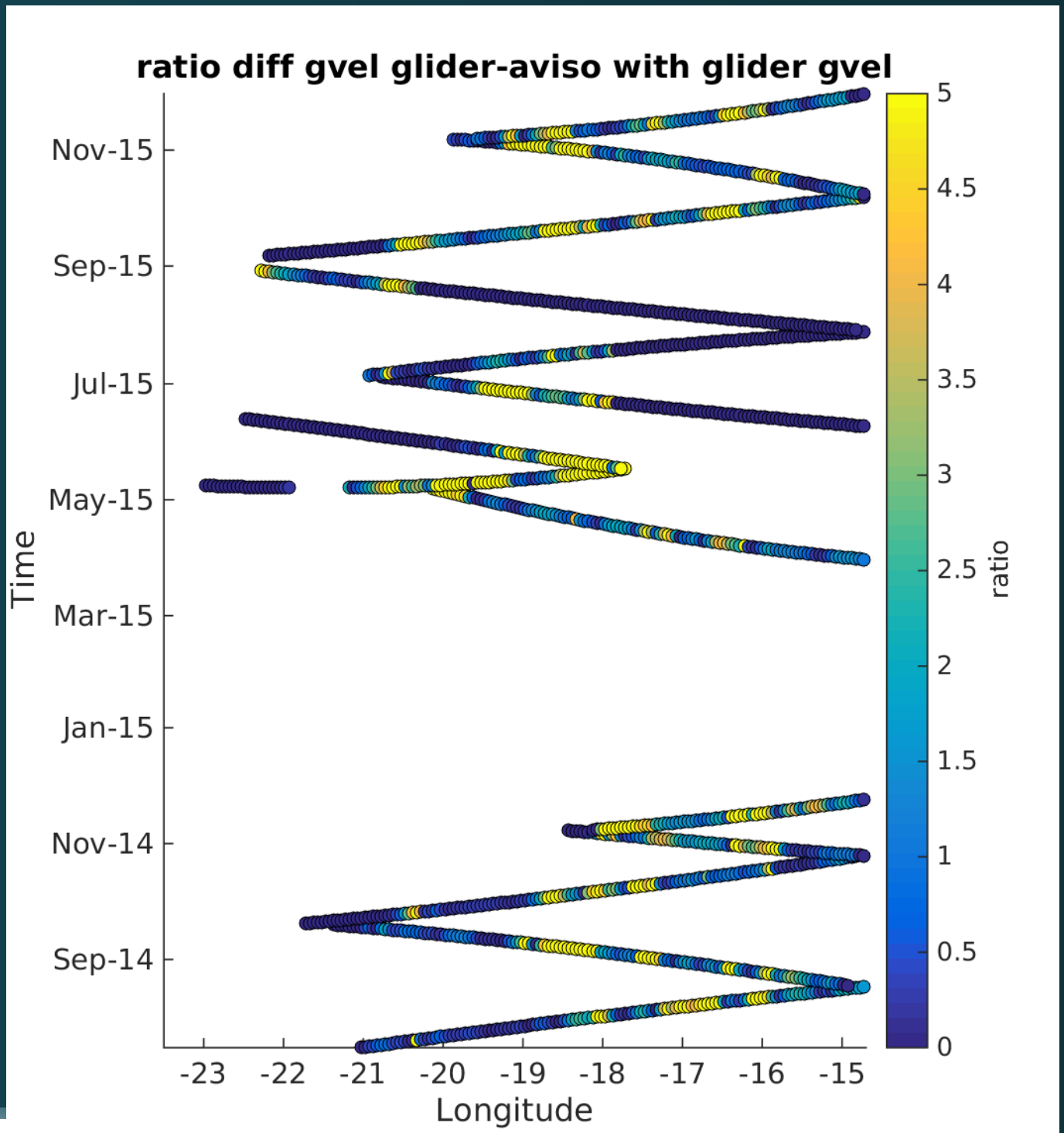
- Between +7Sv and -10 Sv recirculation on the east flank of Iceland Basin (23W-19W)

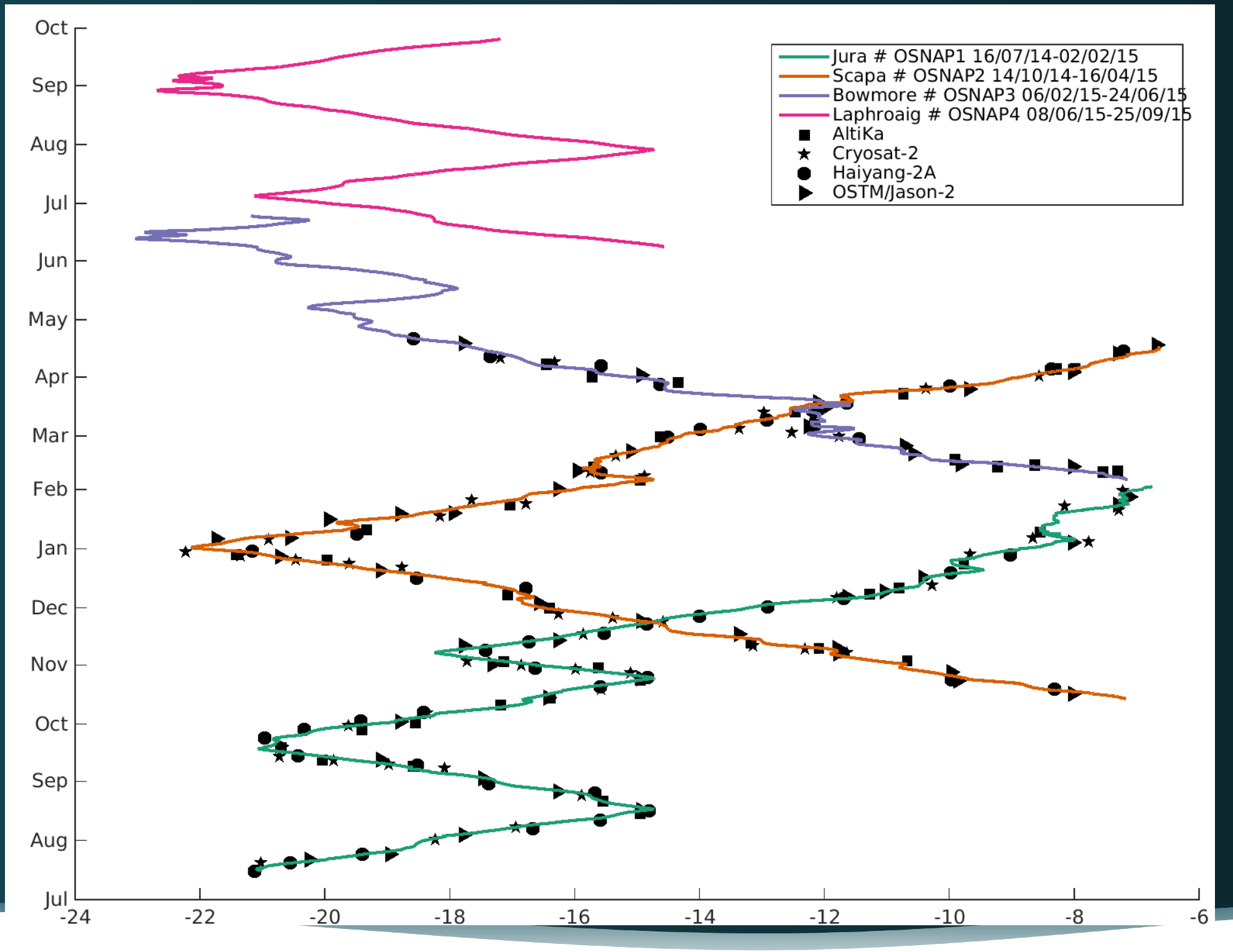
- Most of the flow on Rockall Plateau barotropic (baroclinic shear only contribute to 10% of the absolute transport) → need accurate estimation of DAC! (compass calibration, mooring comparison)

- Absolute transport estimate from a surface reference to AVISO has a mean difference of 2Sv with the glider based estimate (same order than the transport on the Plateau…)

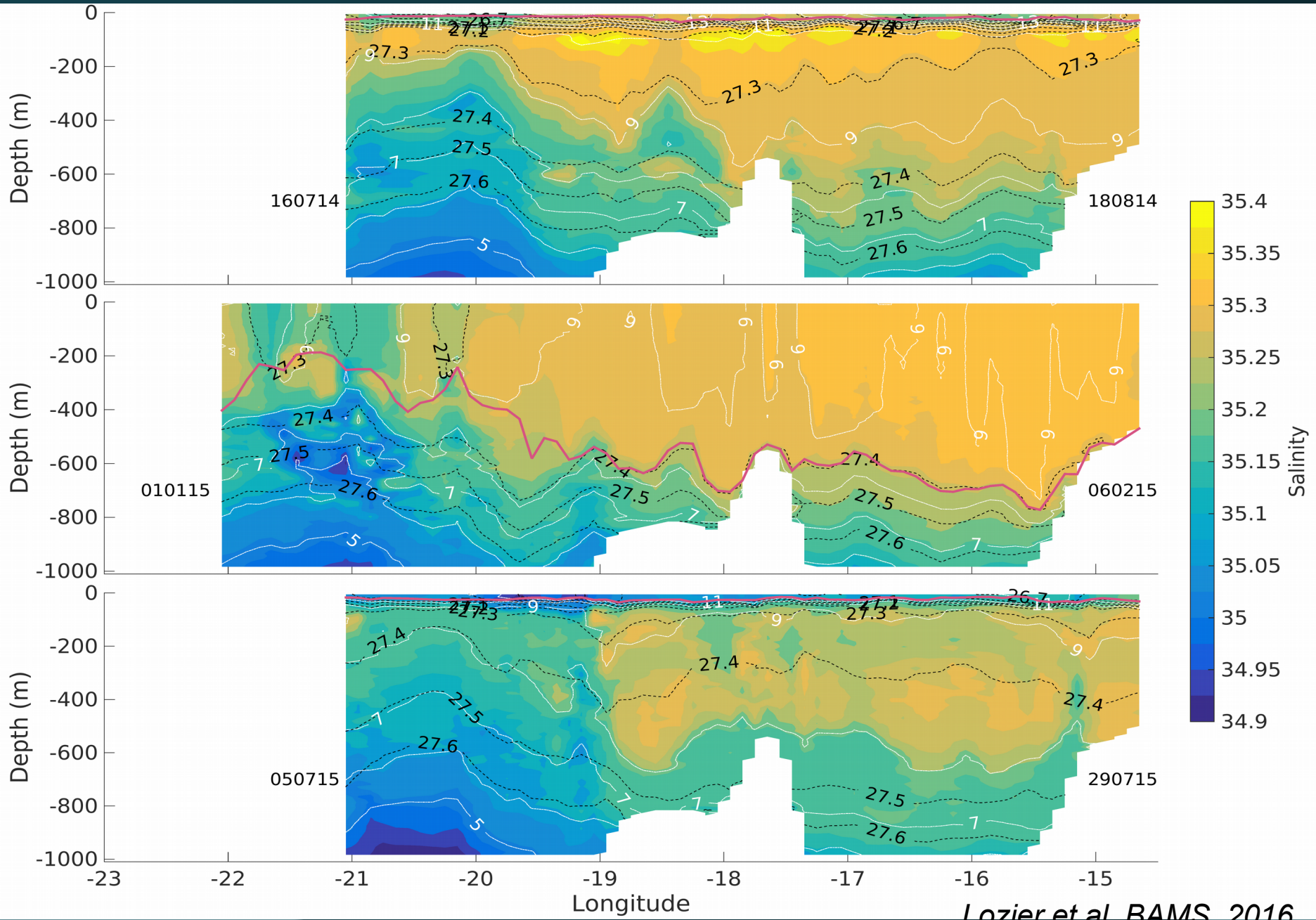
Perspectives: understanding the variability of the transport on the Plateau (mode of variability of the NAC from very high res. model ROMS ~1km)


Glider Salinity. 20 Dec 2014
Thank you
0
-200
-400
-600
-800
-1000
-1200
60
59.5
59
58.5
58
57.5
57
56.5
56
55.5
-14
-12
-10
-8
-6
35.5
35.4
35.3
35.2
35.1
35
34.9


ratio diff gvel glider-aviso with glider gvel
Time
Nov-15
Sep-15
Jul-15
May-15
Mar-15
Jan-15
Nov-14
Sep-14
-23
-22
-21
-20
-19
-18
-17
-16
-15
Longitude
ratio
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0


Jura # OSNAP1 16/07/14-02/02/15
Scapa # OSNAP2 14/10/14-16/04/15
Bowmore # OSNAP3 06/02/15-24/06/15
Laphroaig # OSNAP4 08/06/15-25/09/15
AltiKa
Cryosat-2
Haiyang-2A
OSTM/Jason-2
Oct
Sep
Aug
Jul
Jun
May
Apr
Mar
Feb
Jan
Dec
Nov
Oct
Sep
Aug
Jul
-24
-22
-20
-18
-16
-14
-12
-10
-8
-6

SPMW



Lozier et al. BAMS, 2016