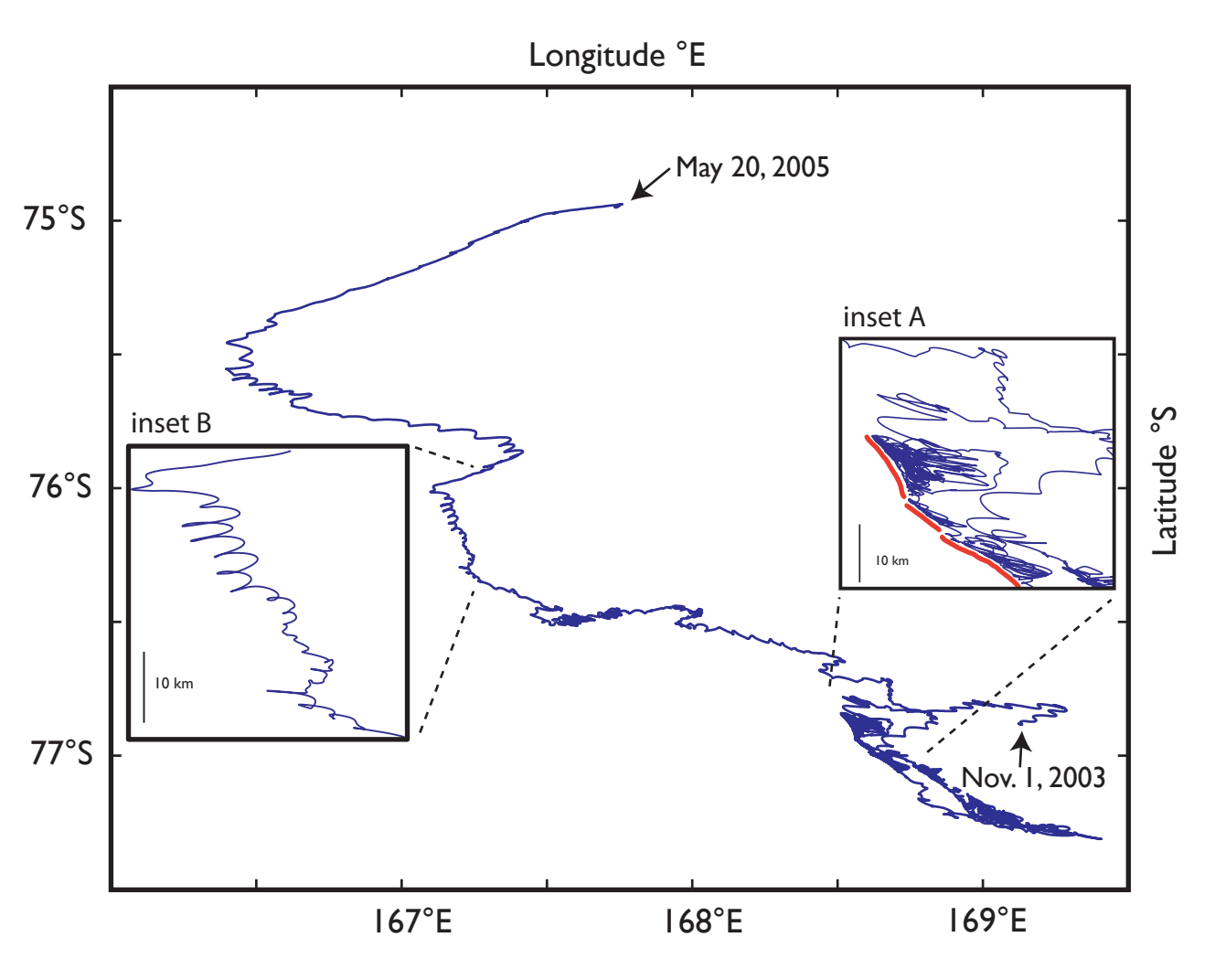
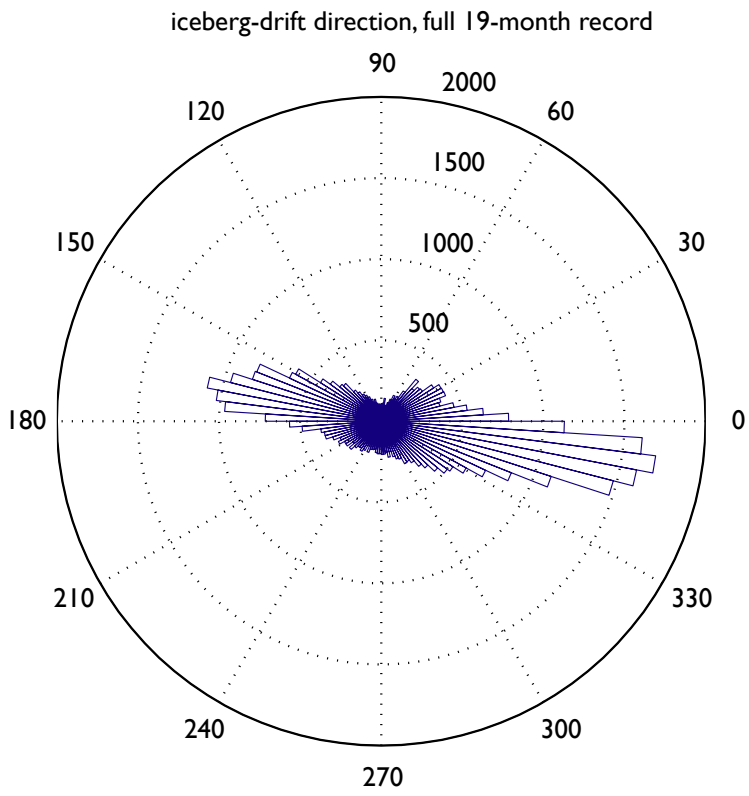
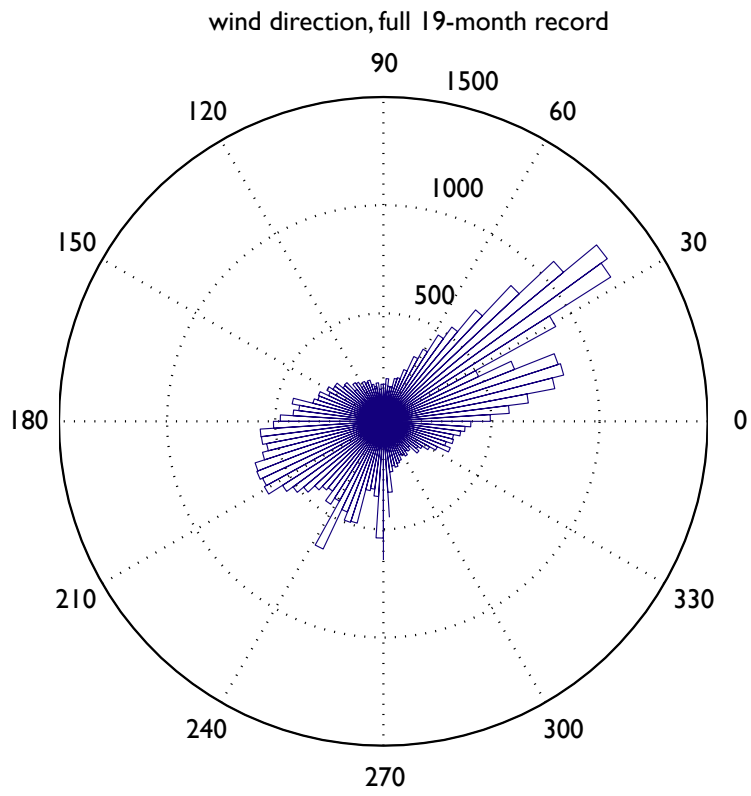
Iceberg interactions with the Ross Air Stream

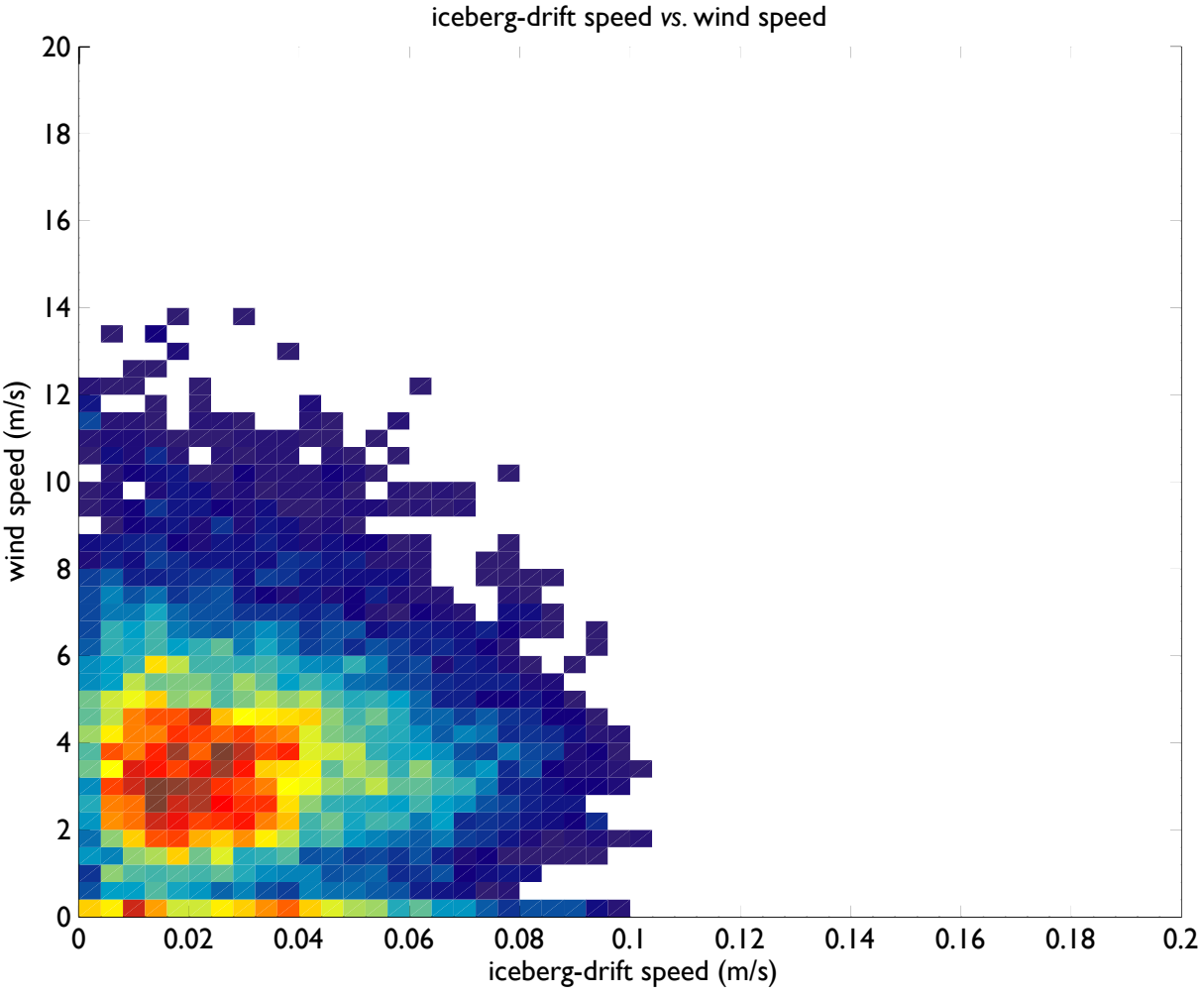
Contributed by the University of Chicago and University of Wisconsin “iceberg research” groups.


Ross Sea
Drygalski Ice Tongue
Franklin Island
fast
sea ice
B15A
B15K
B15J
C16
Lewis Bay
Cape Bird
Laurie II
Ross Island
Windless Bight
Ross Ice Shelf

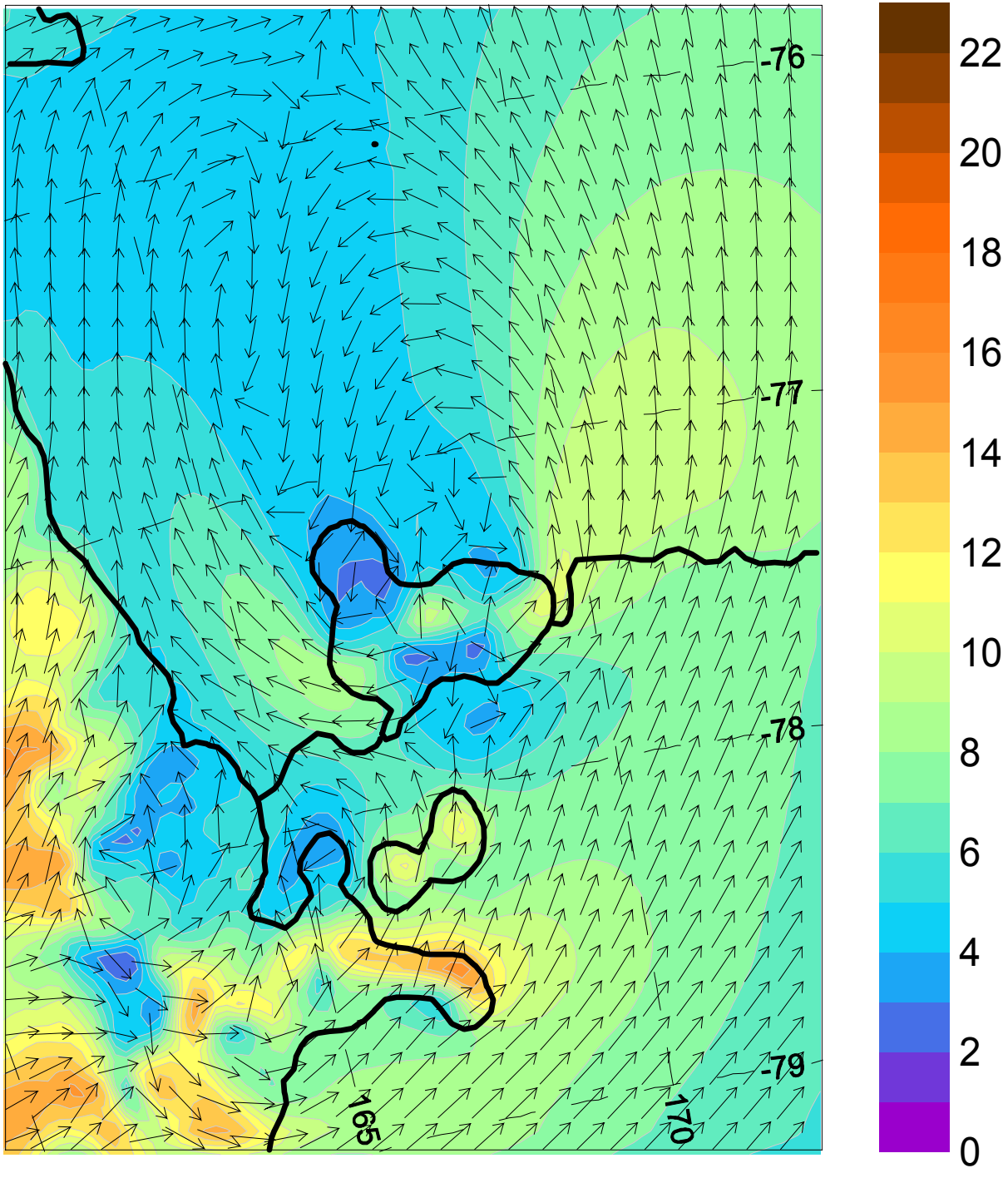

Longitude °E
May 20, 2005
75°S
76°S
77°S
inset A
inset B
10 km
10 km
Nov. 1, 2003
167°E
168°E
169°E
Latitude °S

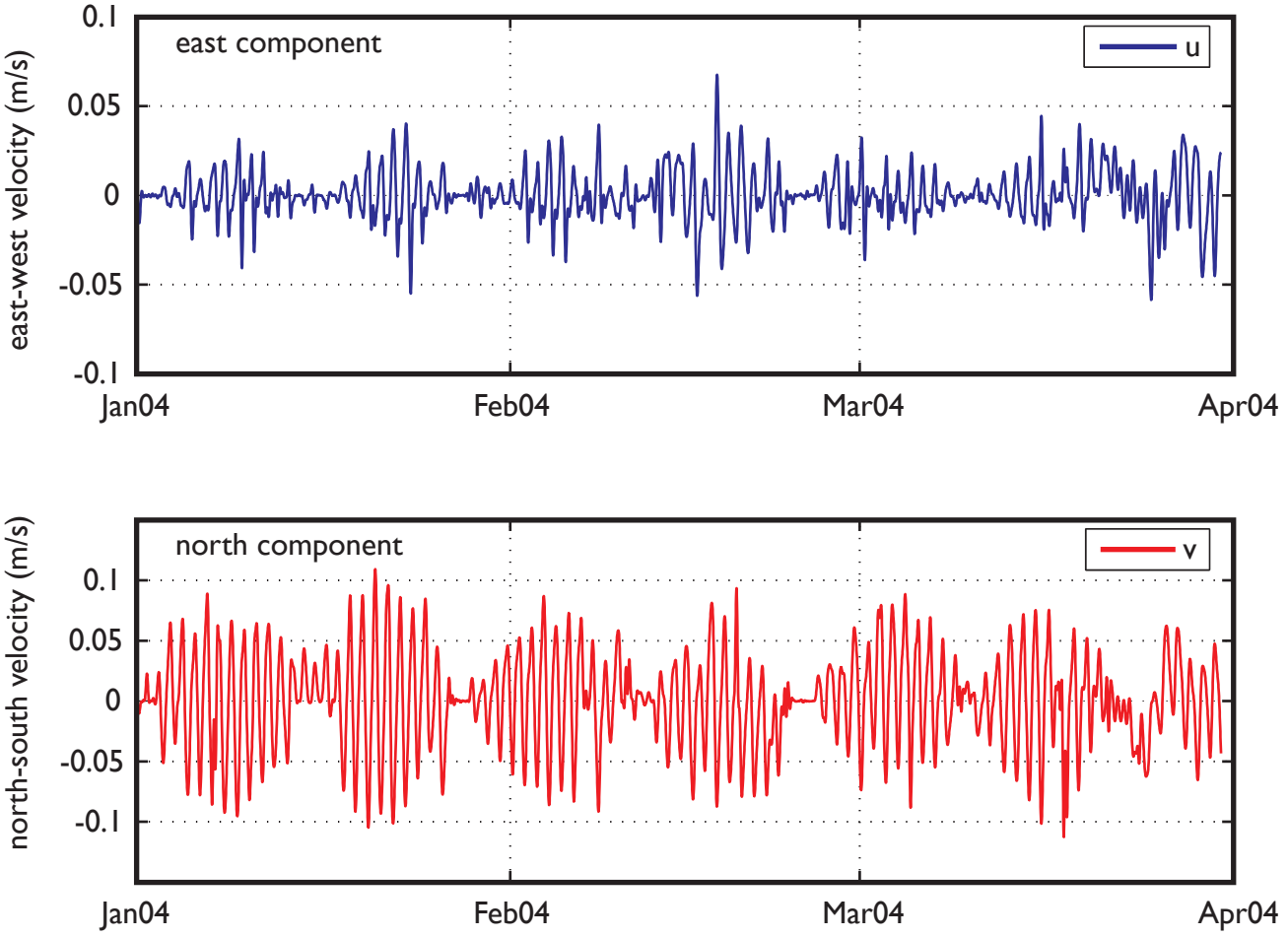

iceberg-drift direction, full 19-month record
90
2000
60
120
1500
30
150
1000
500
180
0
210
330
240
300
270

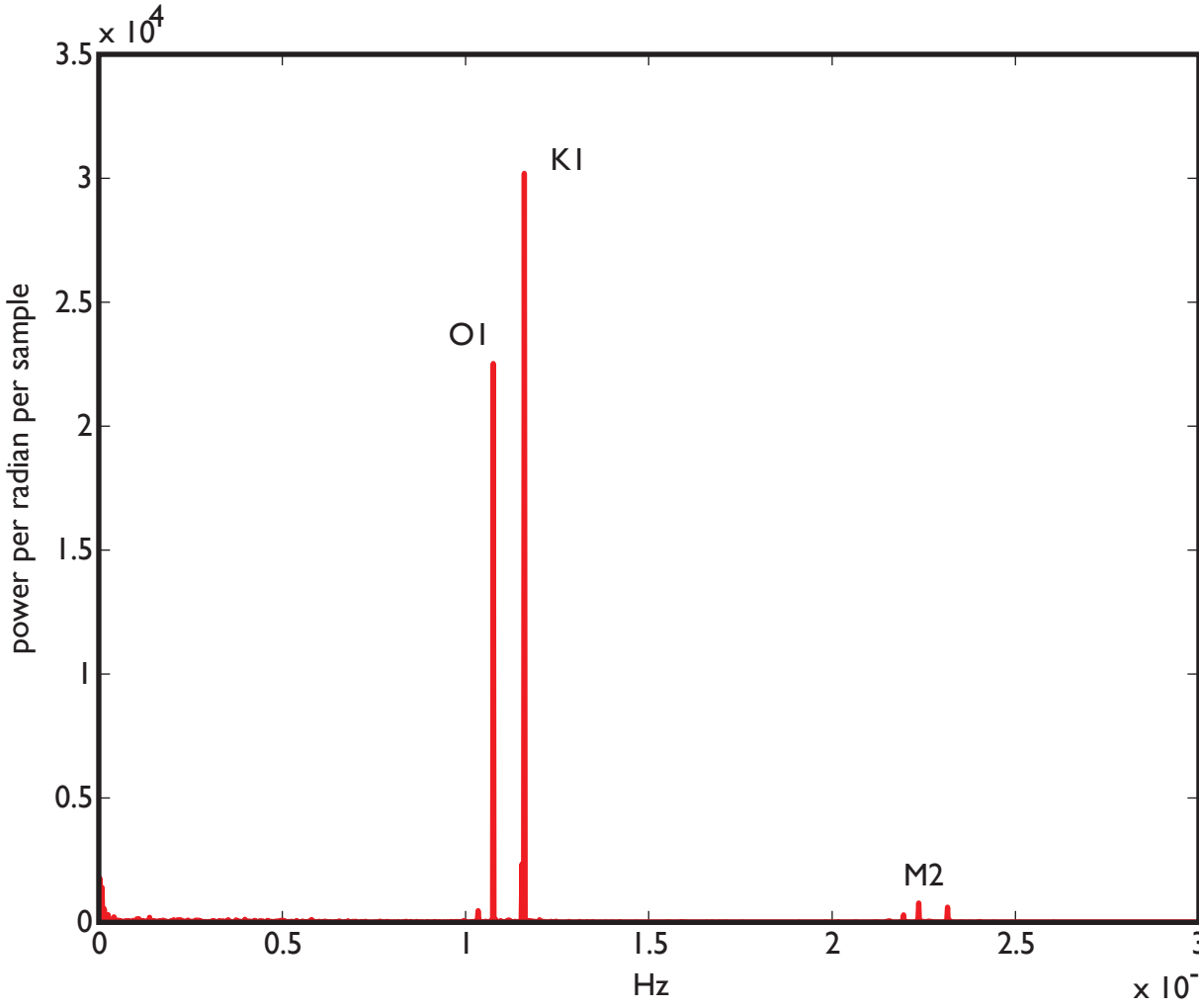

wind direction, full 19-month record
90
1500
60
120
1000
30
150
500
180
0
210
330
240
300
270

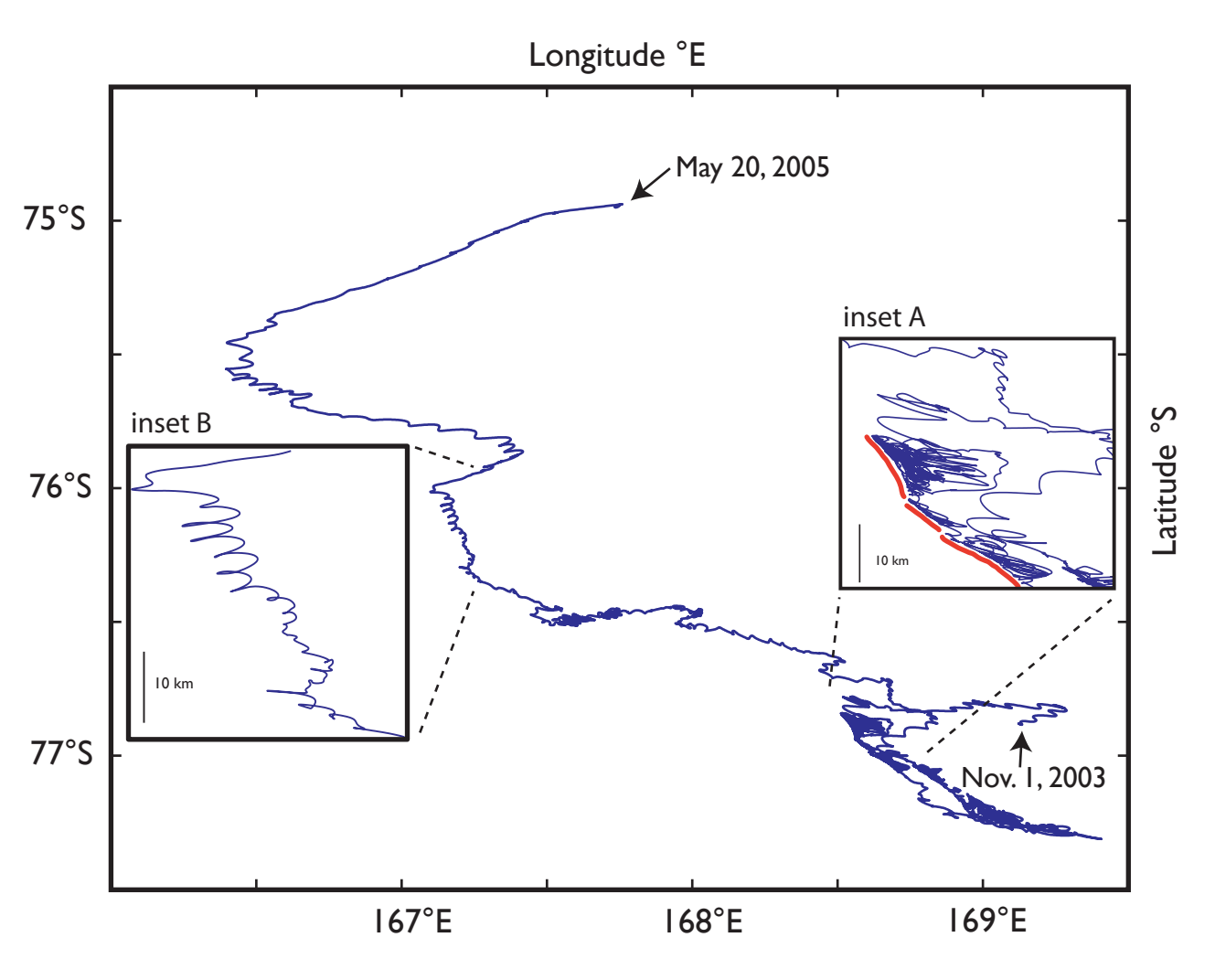

iceberg-drift speed *vs.* wind speed
wind speed (m/s)
iceberg-drift speed (m/s)
0
2
4
6
8
10
12
14
16
18
20
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2

a) ANNUAL




east component
u
east-west velocity (m/s)
0.1
0.05
0
-0.05
-0.1
Jan04
Feb04
Mar04
Apr04
north component
v
north-south velocity (m/s)
0.1
0.05
0
-0.05
-0.1
Jan04
Feb04
Mar04
Apr04


x 10^4
3.5
3
2.5
2
1.5
1
0.5
0
power per radian per sample
K1
O1
M2
0
0.5
1
1.5
2
2.5
3
Hz
x 10^-5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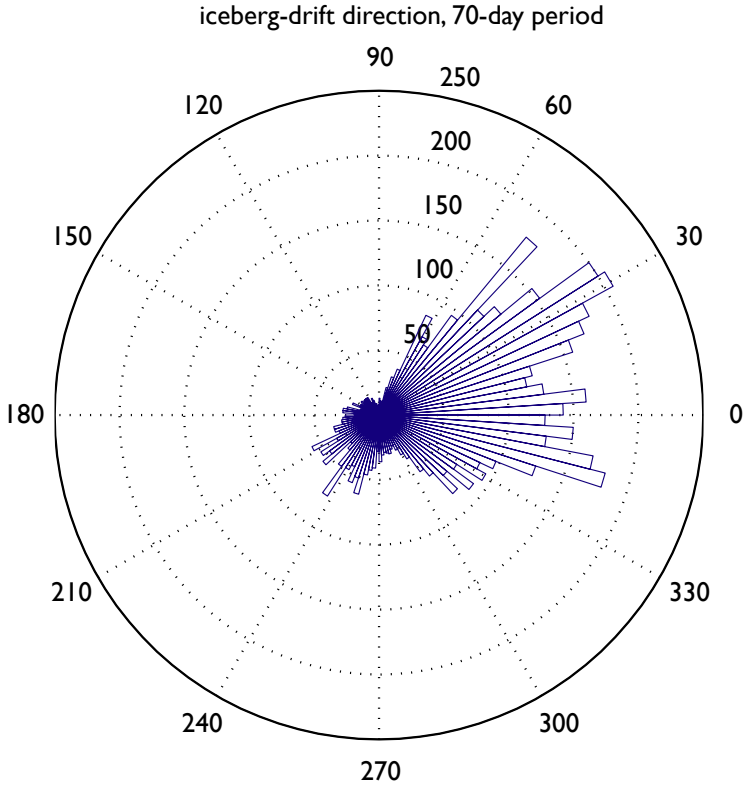
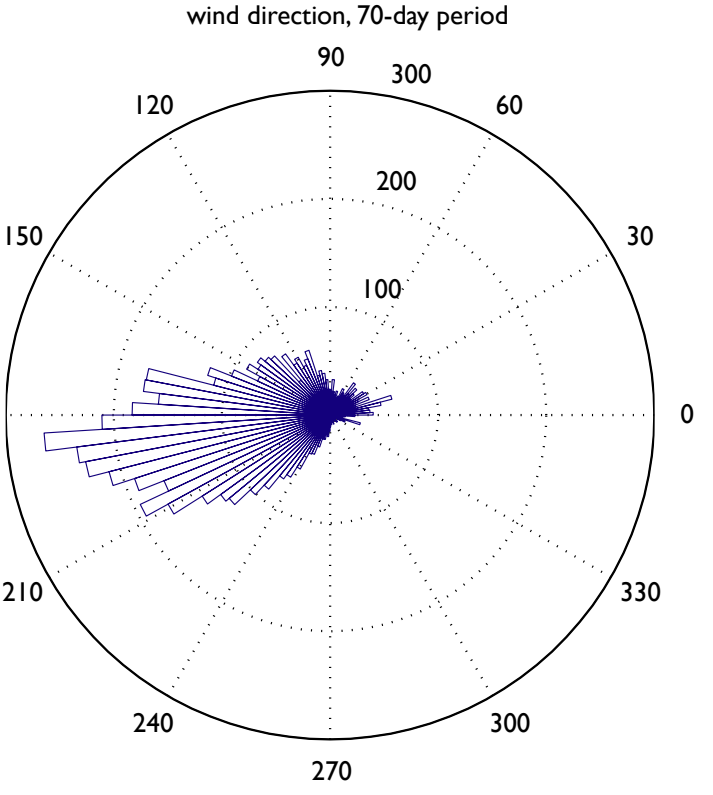
168°E
169°E
Latitude °S


iceberg-drift direction, 70-day period
90
250
60
200
120
150
30
100
150
50
180
0
210
330
240
300
270


wind direction, 70-day period
90
300
60
200
120
150
30
100
180
0
210
330
240
300
270

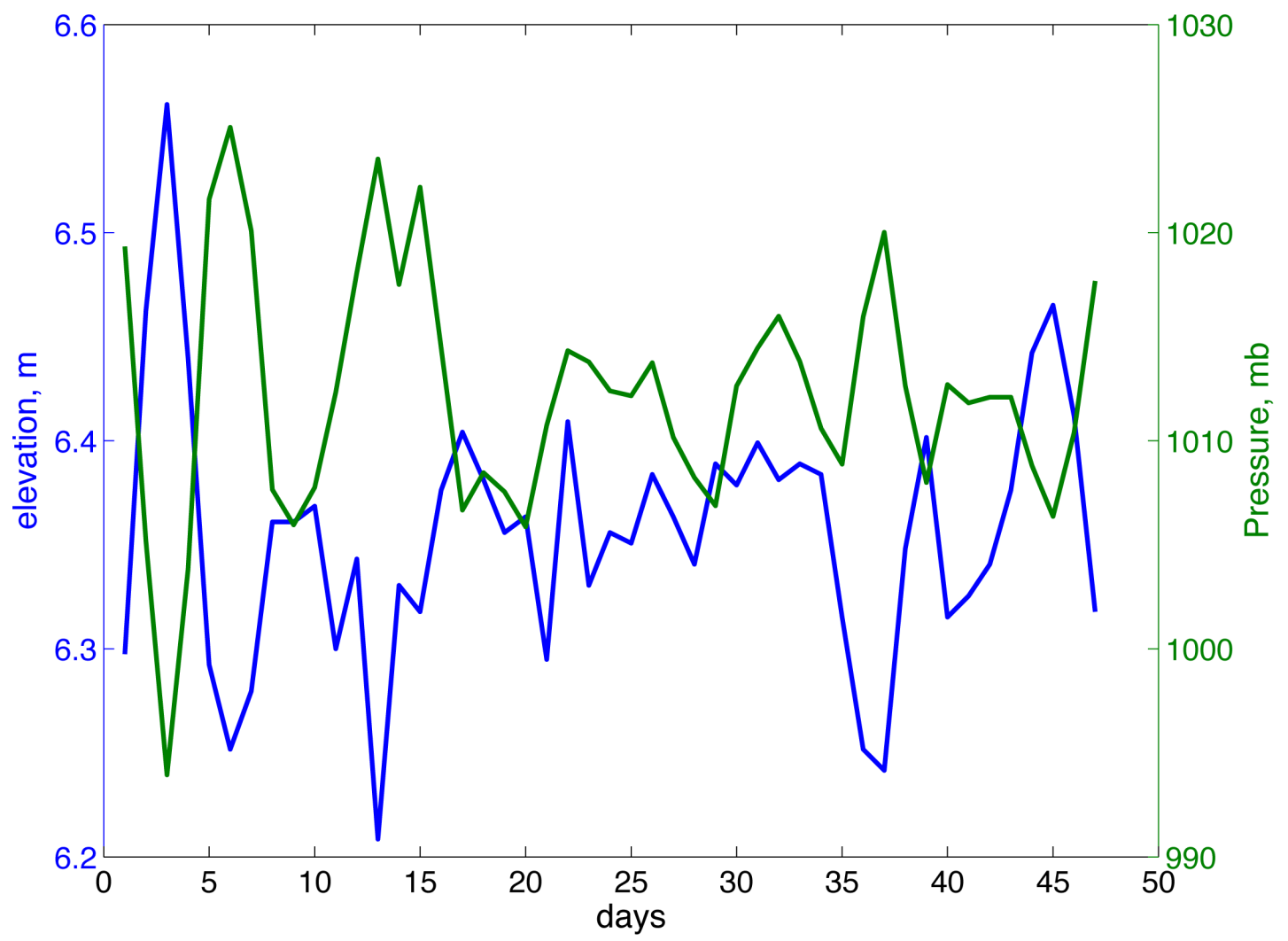
XII. *On the Effect of the Pressure of the Atmosphere on the Mean Level of the Ocean.*

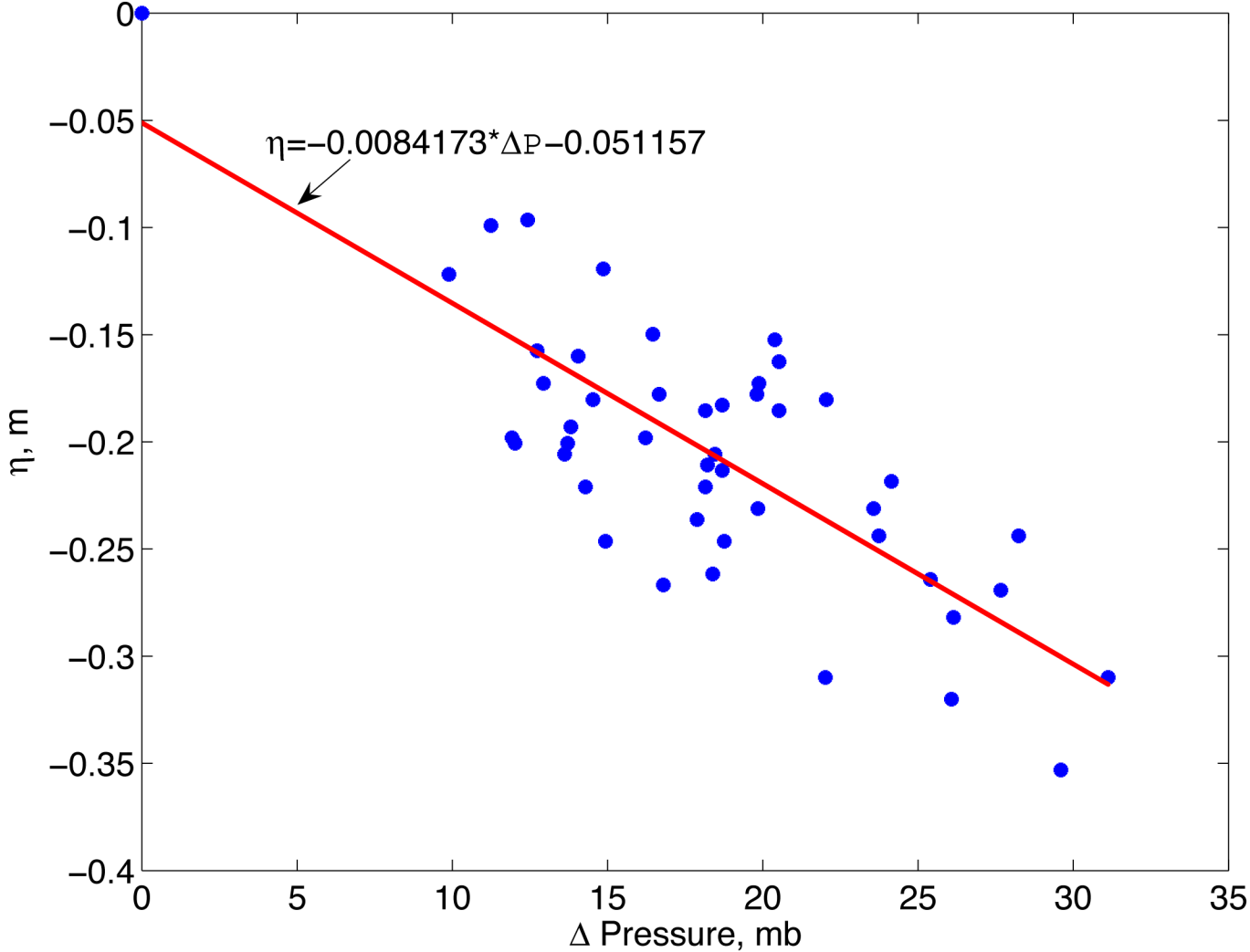
By Captain Sir James Clark Ross, *R.N., D.C.L., F.R.S. &c.*

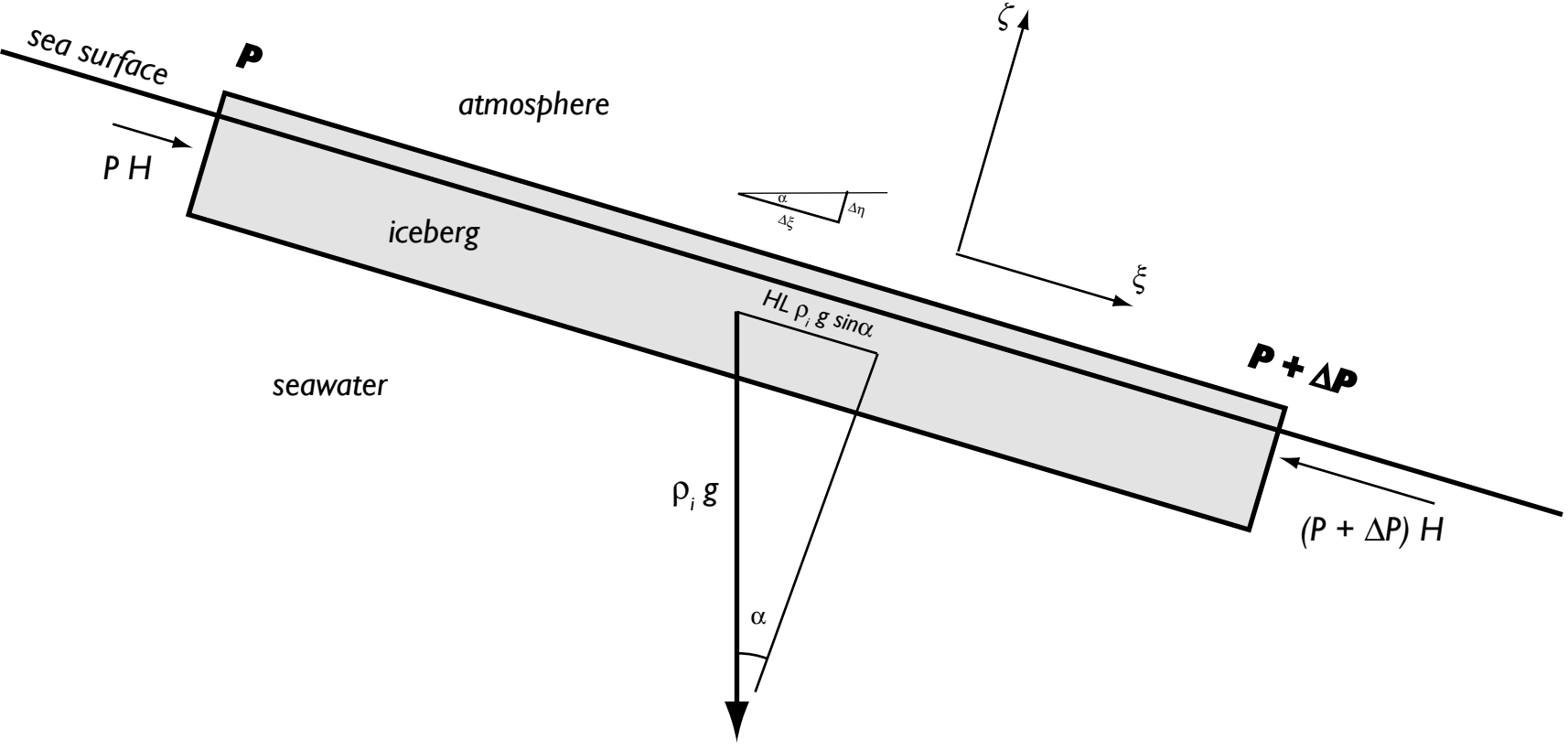
Received June 15,—Read June 15, 1854.

In September 1848 Her Majesty's ships Enterprize and Investigator entered the harbour of Port Leopold, in latitude 74° N. and longitude 91° W., for the purpose of establishing there a depôt of provisions, and of extending, in boats, the examination of the north, south, and west coasts of North Somerset, in search of the missing expedition under the command of Sir John Franklin. No sooner, however, were the ships anchored, than a heavy pack of ice was driven down upon, and completely closed the harbour's mouth, and this effectually preventing their egress, they were compelled there to pass the winter of 1848–49.

It was during that period that the series of observations, which I have now the honour of submitting to the consideration of the Royal Society, on the effect of the pressure of the atmosphere on the level of the ocean, was obtained, and as it was made under peculiarly favourable circumstances, which I shall presently point out, I have no doubt it will contribute to throw some light on the movements of the tides, and on some of the causes of their apparent irregularities, not only in the Polar regions, but also along our own coasts, which have not hitherto been detected, or have not received that attention their importance demands.


6.6
6.5
6.4
6.3
6.2
elevation, m
1030
1020
1010
1000
990
Pressure, mb
0
5
10
15
20
25
30
35
40
45
50
days


η=−0.0084173*ΔP−0.051157
η, m
Δ Pressure, mb
0
−0.05
−0.1
−0.15
−0.2
−0.25
−0.3
−0.35
−0.4
0
5
10
15
20
25
30
35


sea surface
P
atmosphere
P H
iceberg
seawater
ζ
ξ
α
Δξ
Δη
HL ρi g sinα
P + ΔP
ρi g
α
(P + ΔP) H

$$\eta = \frac{-P'_{ATM}}{\rho_w g}$$

$$F_g = HL\rho_i g \sin\alpha$$

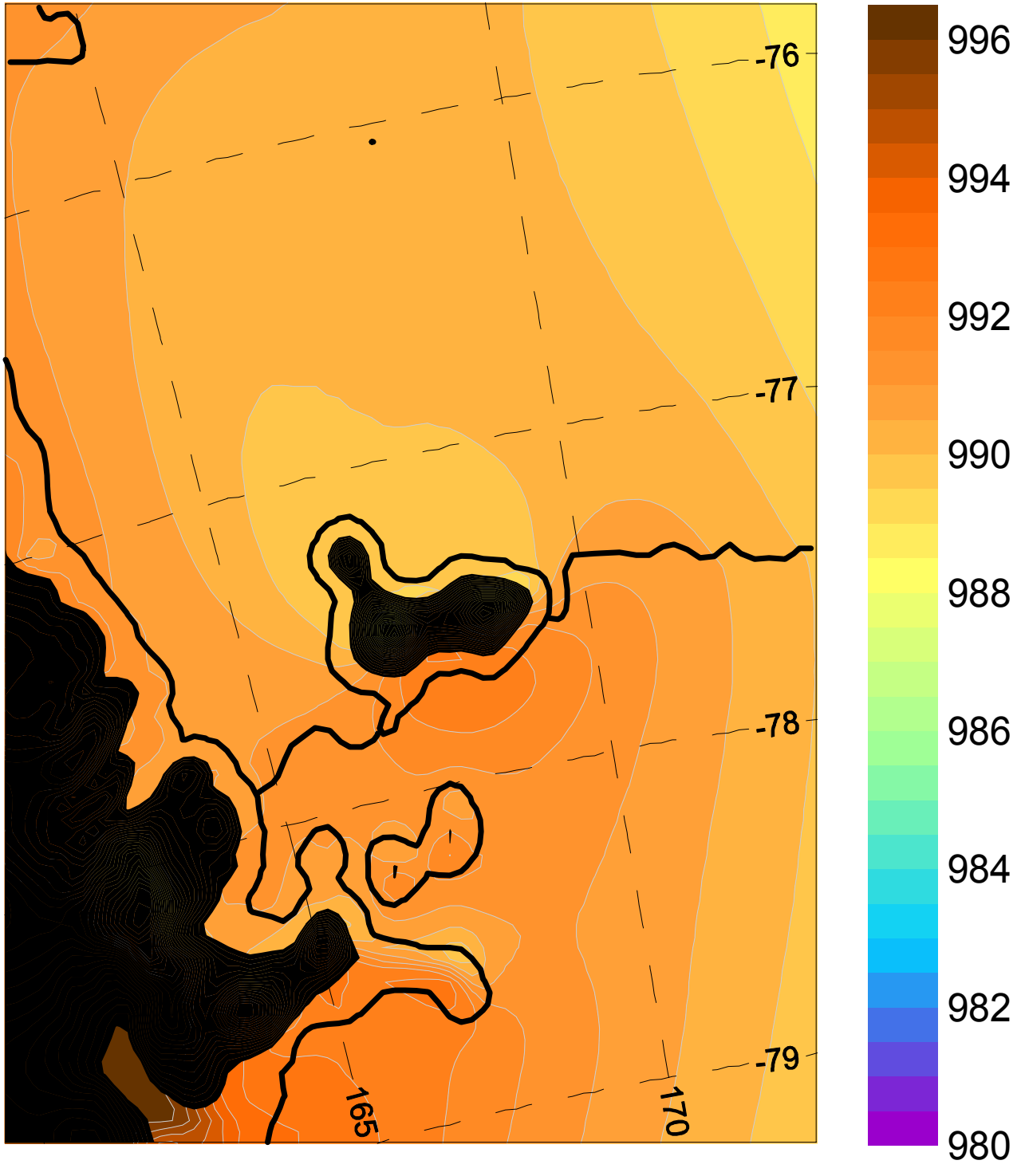
$$F_L = HP + \frac{\rho_w g}{2}\frac{\rho_i^2}{\rho_w^2}H^2$$

$$F_R = -HP - H\Delta P - \frac{\rho_w g}{2}\left(\frac{\rho_i}{\rho_w}\right)^2 H^2$$

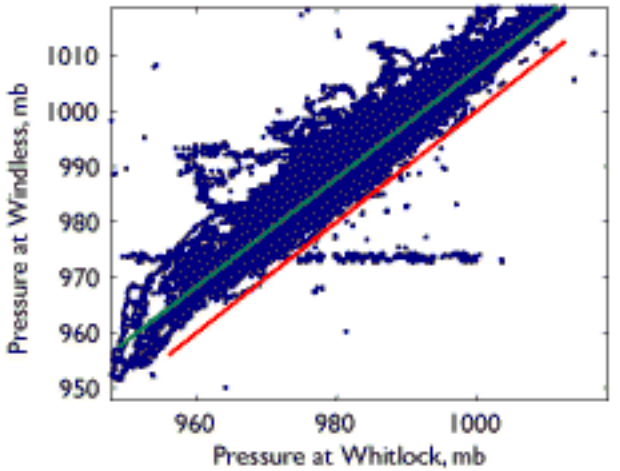
$$\sin\alpha = \frac{\Delta P}{\rho_w g L}$$

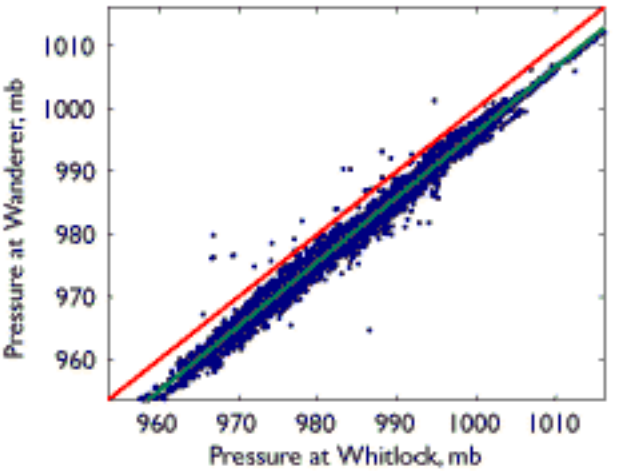
$$F = \left(\frac{\rho_i}{\rho_w} - 1\right)H\Delta P$$

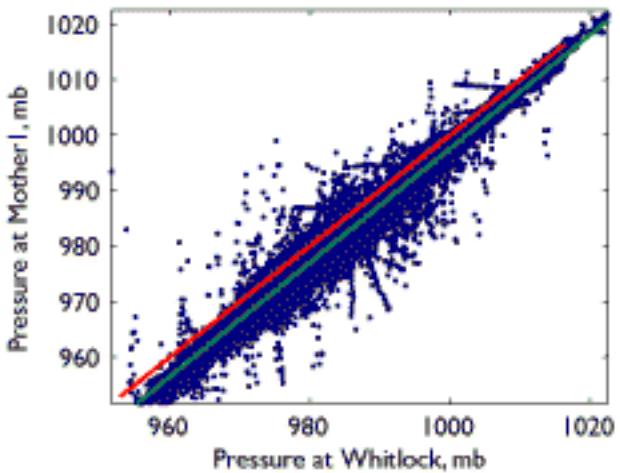
a) ANNUAL

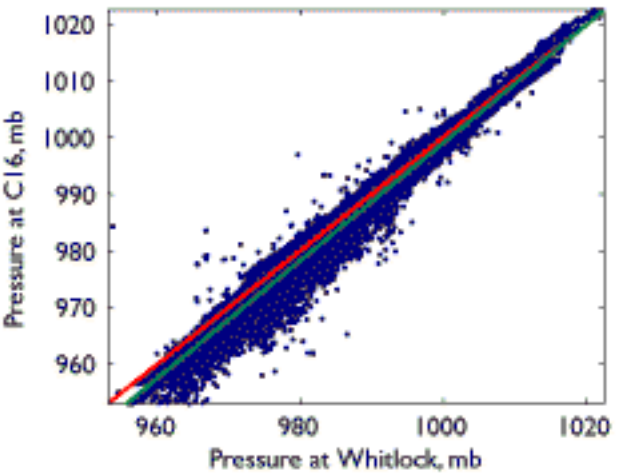


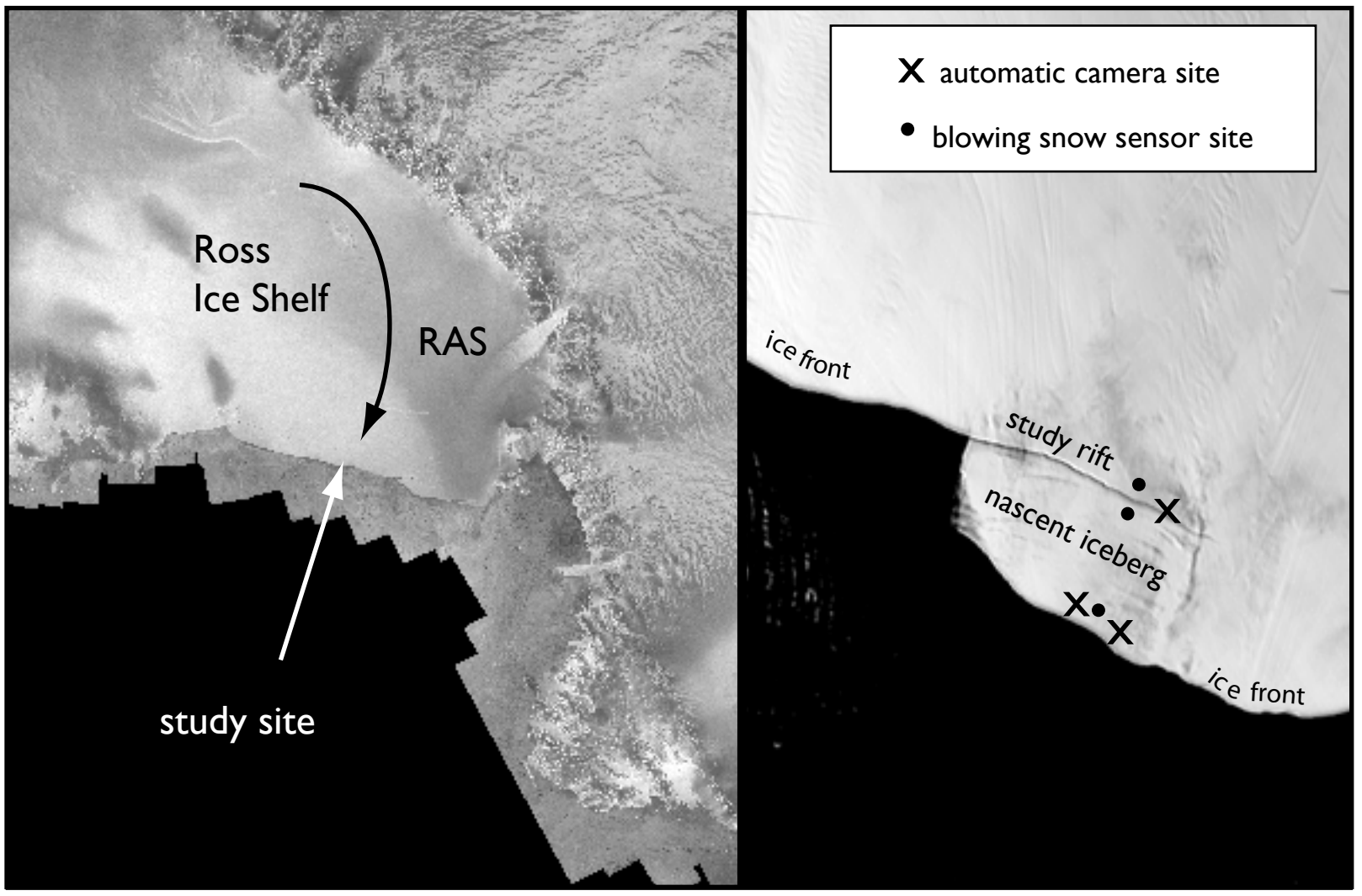

Ross Sea
Drygalski Ice Tongue
Franklin Island
fast
sea ice
B15K
B15A
B15J
C16
Lewis Bay
Cape Bird
Laurie II
Ross Island
Windless Bight
Ross Ice Shelf

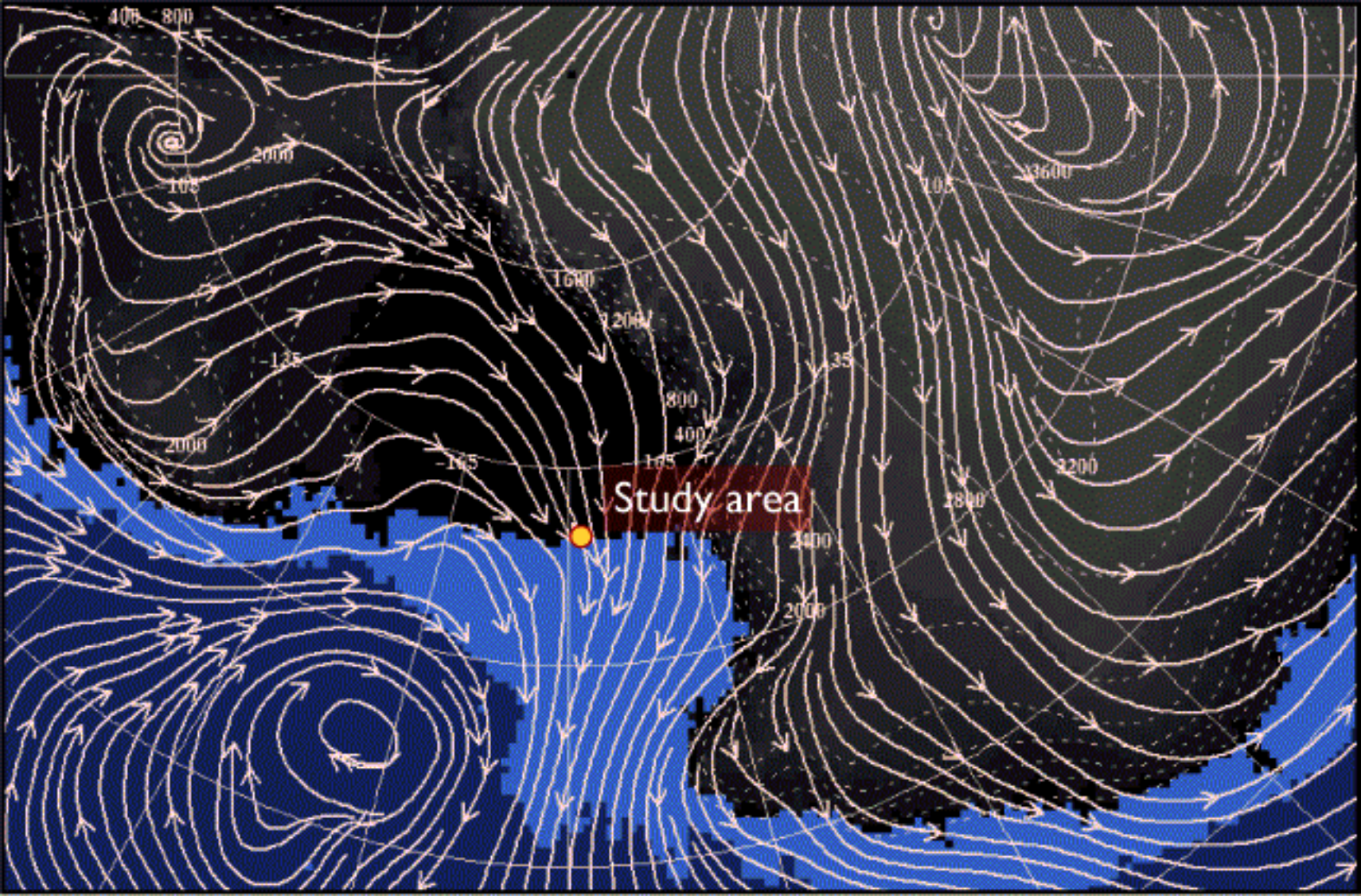

Pressure at Windless, mb
1010
1000
990
980
970
960
950
960
980
1000
Pressure at Whitlock, mb

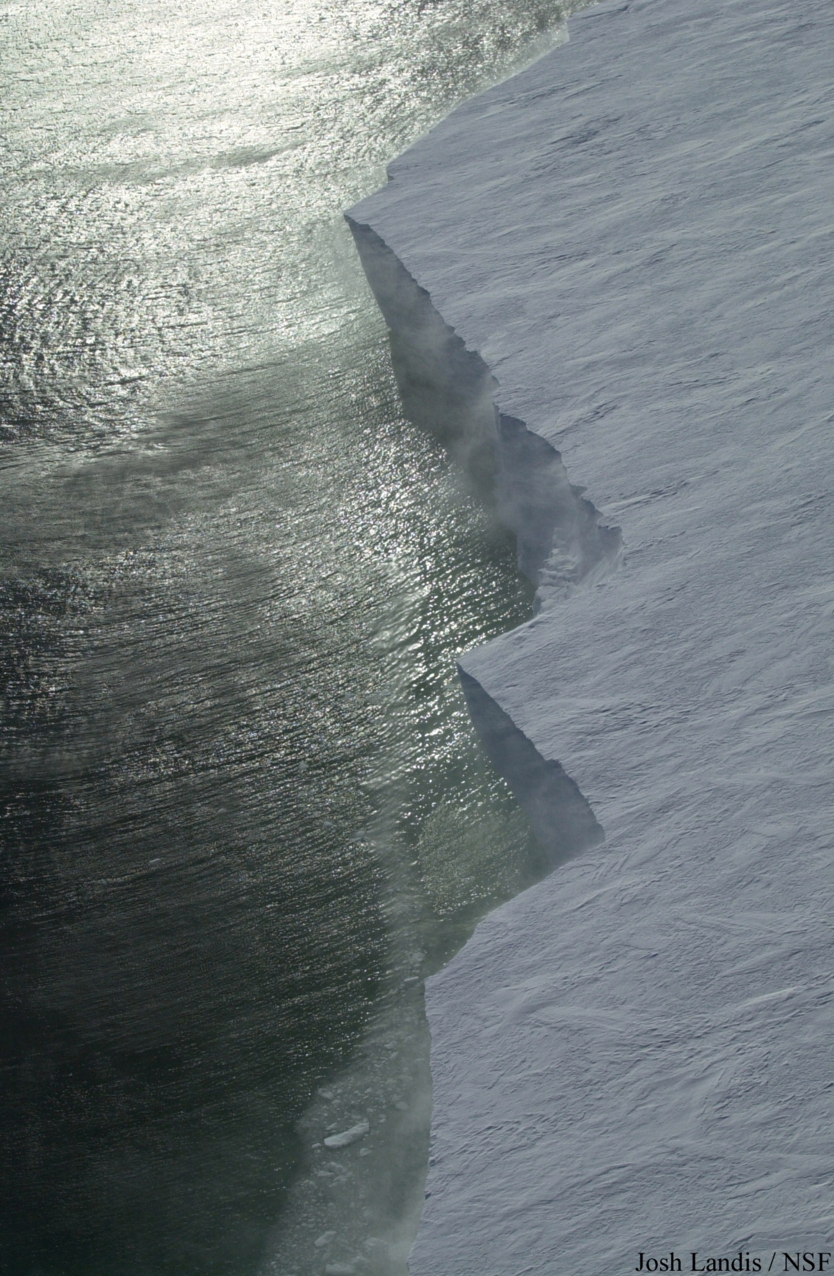

Pressure at Wanderer, mb
1010
1000
990
980
970
960
960
970
980
990
1000
1010
Pressure at Whitlock, mb

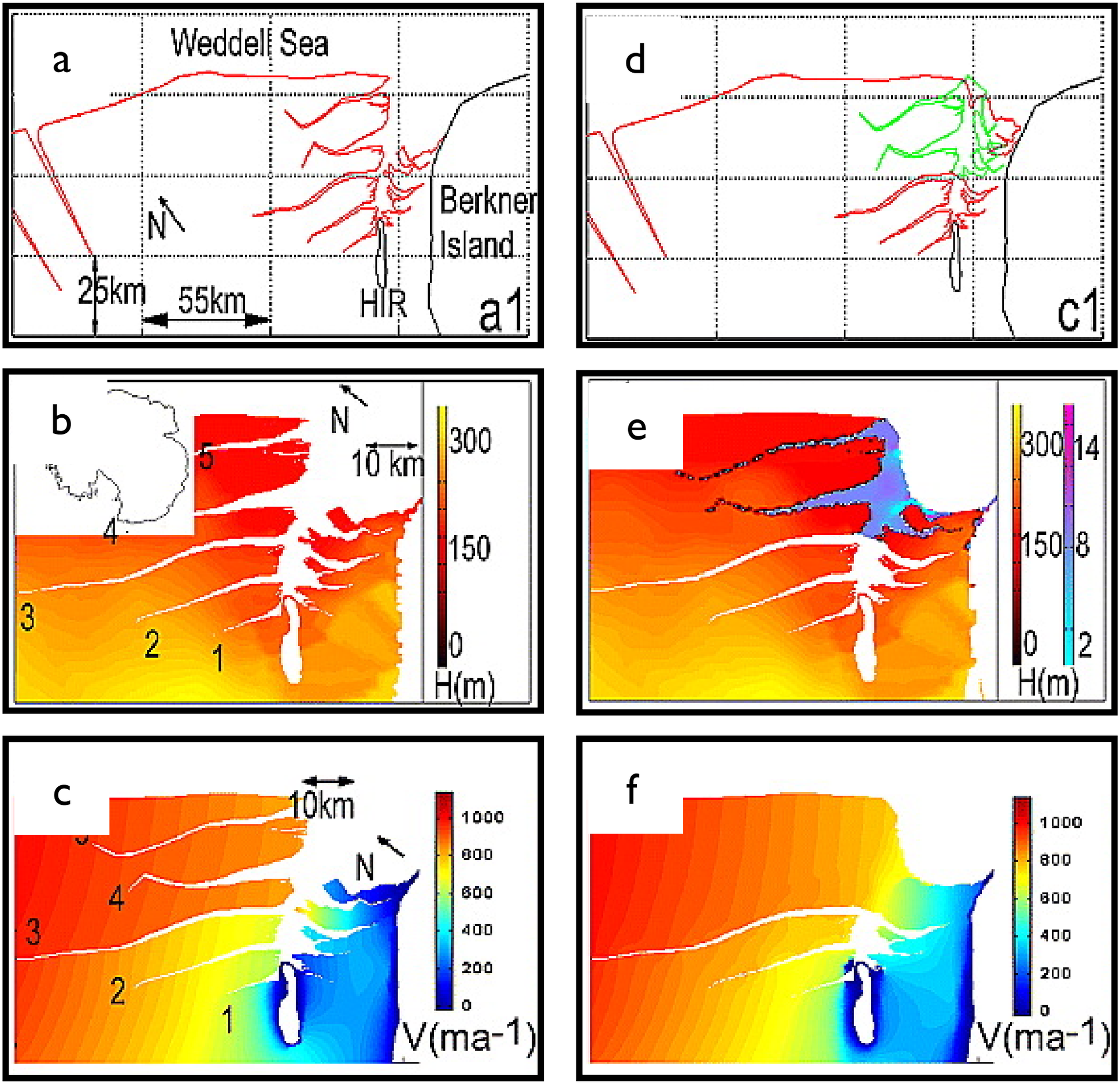

Pressure at Mother I, mb
1020
1010
1000
990
980
970
960
960
980
1000
1020
Pressure at Whitlock, mb


Pressure at C16, mb
1020
1010
1000
990
980
970
960
960
980
1000
1020
Pressure at Whitlock, mb


Ross
Ice Shelf
RAS
study site
X automatic camera site
• blowing snow sensor site
ice front
study rift
nascent iceberg
ice front


Study area


Josh Landis / NSF


a
Weddell Sea
N
Berkner
Island
25km
55km
HIR
a1
d
c1
b
N
10 km
5
4
3
2
1
300
150
0
H(m)
e
300
150
0
14
8
2
H(m)
c
10km
N
4
3
2
1
1000
800
600
400
200
0
V(ma-1)
f
1000
800
600
400
200
0
V(ma-1)