Morphodynamics and sediment dynamics

C. L Amos, G Umgiesser & M Bonardi

SUPPORT PERSONNEL

S. Cappucci, C. Thompson, M. Angelaki (P.hD)
P. Reed, D. Brown (M.Sc)
K. Chick, C. Cotterill, G. Munford, G.Tremblay (B.Sc)

with support from:

P. Capostrini (CORILA, Venezia)
Life Barene Project (Burano)
M. Flindt (Univerity of Odense, Denmark)
F-ECTS (A. Bergamasco, THETIS SpA)
BIOFLOW (L. van Duren, NIOO, Holland)
Euro-Delta (F. Trincardi, CNR, IGS, Italy)
EUROSTRATAFORM (P. Weaver, SOC, UK)

Deliverables to CORILA project

OVERALL OUTPUT - calibrated/coupled sedimentation model for Venice Lagoon

SCIENTIFIC DELIVERABLES:

Paper 1: Bio-roughness evaluation and accurate estimations of bed stress (Lab Carousel)
Paper 2: Box model and sensitivity analysis of sedimentation of P. di Cona
Paper 3: Sedimentation parameters in Venice Lagoon (Sea Carousel/Mini Flume)
Paper 4: Algal mass transport & contribution to bed scour
Paper 5: In situ spectral estimates of bed stress and sup pression by turbidity
Paper 6: Wave resuspension in Venice Lagoon
Paper 7: The role of submerged beaches in coastal protection
Thesis 1 (M.Sc): Mass transports and frontal impact on scour (Treporti)
Thesis 2 (B.Sc): Residual sand transport as bedload & mechanisms (Lido)
Thesis 3 (B.Sc): Submerged beaches - role in wave suppression (P. della Centrega)
Thesis 4 (B.Sc): Residual fines transport in suspension & mechanisms (Scanello-Burano)
Thesis 5 (B. Sc): Role of buoyant aggregates on Palude stability (P. dei Lagi)
Thesis 6 (P.hD): Factors controlling sedimentation on P. di Cona
Thesis 7 (P.hD): The role of the solid-transmitted stress of mobile sand in bed erosion

ALL OUTPUTS SUPPLIED IN DIGITAL FORMAT TO CORILA

Timetable of events

2002

- Update SEDTRANS @ SOC
- Examination of Thesis 1 - submit to CORILA
- Examination of Theses 2,3,4 & 6 - submit to CORILA
- Submit Paper 1 - Journal of Coastal Research….
- Submit Papers 3 & 4 - Sedimentolog…..

Submit CD-rom of papers and data

2003

- Wave resuspension field monitoring
- Complete box model - submit Paper 2
- Examination of Thesis 5
- Euro-Delta - high resolution geophys. survey
- Submit Paper 5 - Journal Geophysical Research
- Submit Papers 6 and 7 - Estuarine, Coastal, Shelf Science

Submit CD-rom of papers and data

2004(ext)

- Examination of Thesis 7- submit to CORILA
- Submit Paper 6
- BIOFLOW workshop - in situ methods
- EUROSTRATAFORM - Sea Carousel

Laboratory/analytical work at SOC

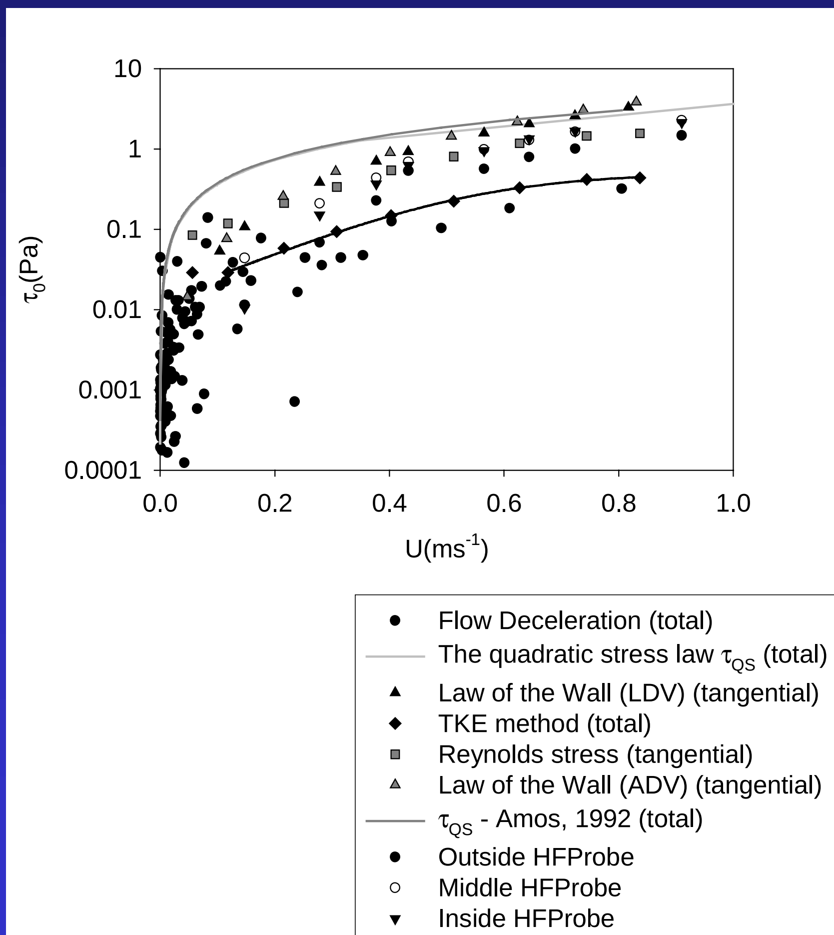
LAB CAROUSEL

- **bioroughness measurement and bed stress evaluation (BIOFLOW, C. Thompson)**
- **turbulence (stress) suppression by sediments (D. Cloutier, M. Angelaki)**
- **algal transport & solid transmitted stress (M. Flindt)**
- **the role of sand in scouring of mud**

ANALYTICAL

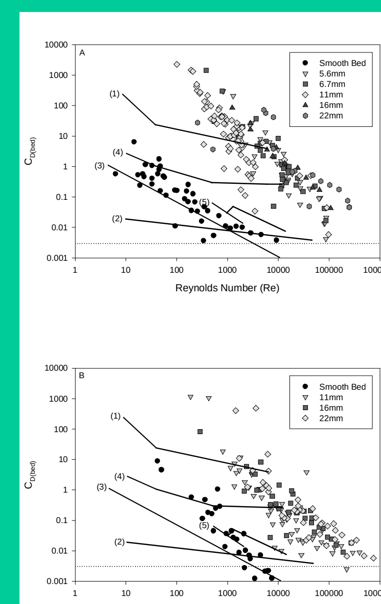
- **Box model of Palude di Cona (S Cappucci, G. Umgiesser)**
- **Turbulent stresses over natural roughnesses (C. Thompson)**
- **sedimentation/erosion parameters (C. Amos)**

Laboratory/analytical work at SOC

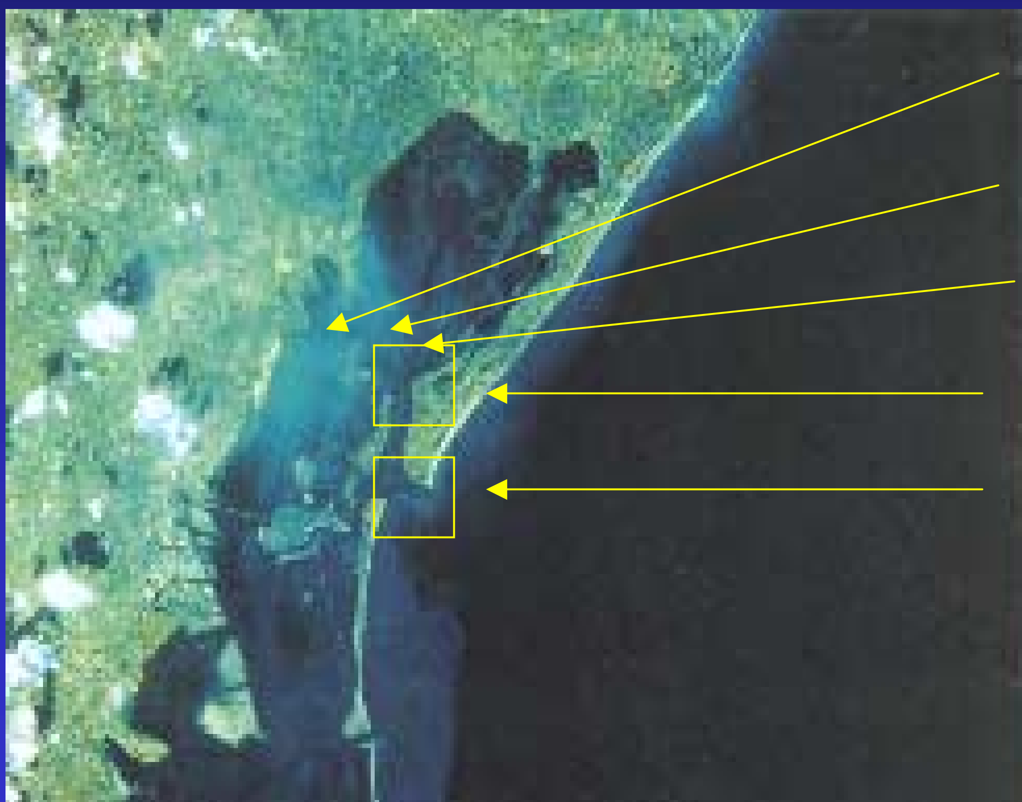


$$F_D = m\frac{d\bar{u}}{dt} = \tau A = \varepsilon\rho\frac{d^2\bar{u}}{dy^2} = AC_D\rho\bar{u}^2$$

$$C_D = \frac{m}{A}\frac{d\bar{u}}{dt}\frac{1}{\rho\bar{u}^2} = f\left(\frac{d_{50}}{h};\frac{\bar{u}_*\rho d_{50}}{\mu}\right)$$



Summer field work in Venice Lagoon
August-September, 2001



- **buoyant aggregates in mudflat evolution (K. Chick)**
- **sediment fluxes Scanello - Burano - Palude dei Monti (G. Tremlay)**
- **submerged beaches - Palude della Centrega (G. Munford)**
- **ADCP/bathymetric survey - Treporti-Burano-S. Felice system (P. Reed)**
- **sidescan mosiac/bathymetry (C. Cotterill)**
- **seabed sampling (Lido-Desile)**

University of Southampton

CORILA

Southampton Oceanography Centre
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

Seabed measurements in Venice Lagoon

Re-analysis and publication of results collected in 1998/1999 (Sea Carousel & Mini Flume)

- Digital data base (CR-rom) in preparation

- scientific papers in preparation

(1) Factors affecting mudflat stability

(2) Turbulence measurements in estimating
- bottom roughness/shear stress
- turbidity surpression of stress

(3) Laboratory analyses of solid-transmitted stress due to Ulva (M. Flindt)

↓

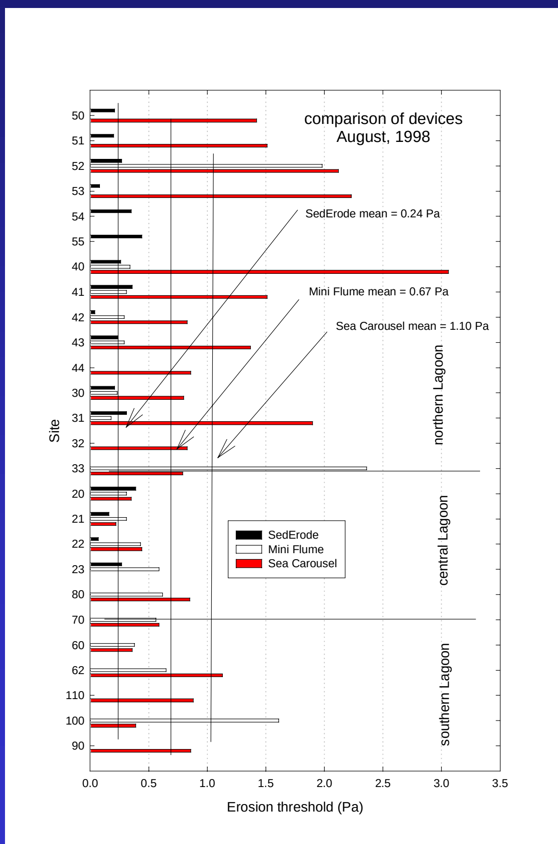
SEDTRANS

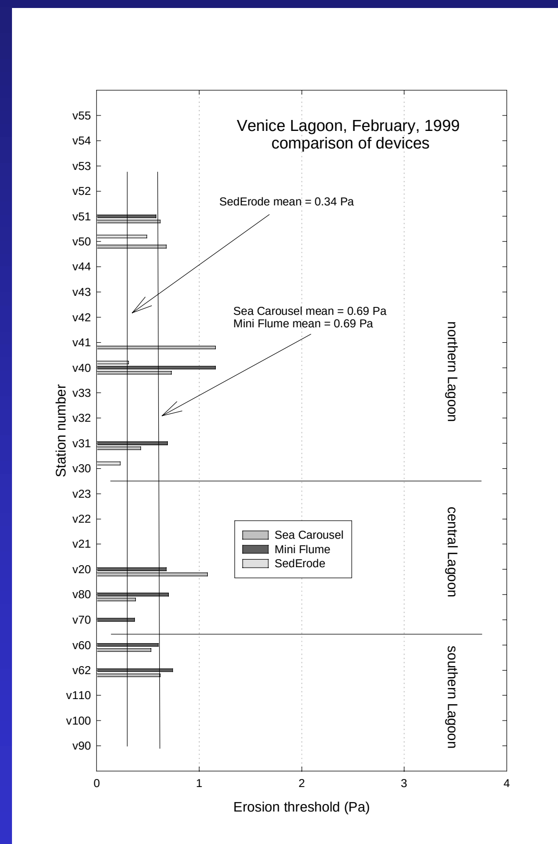
University of Southampton

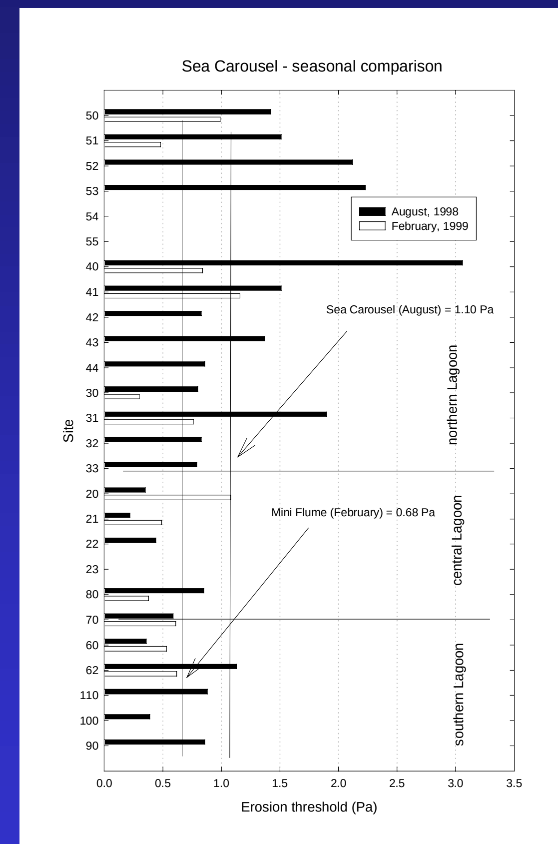
CORILA

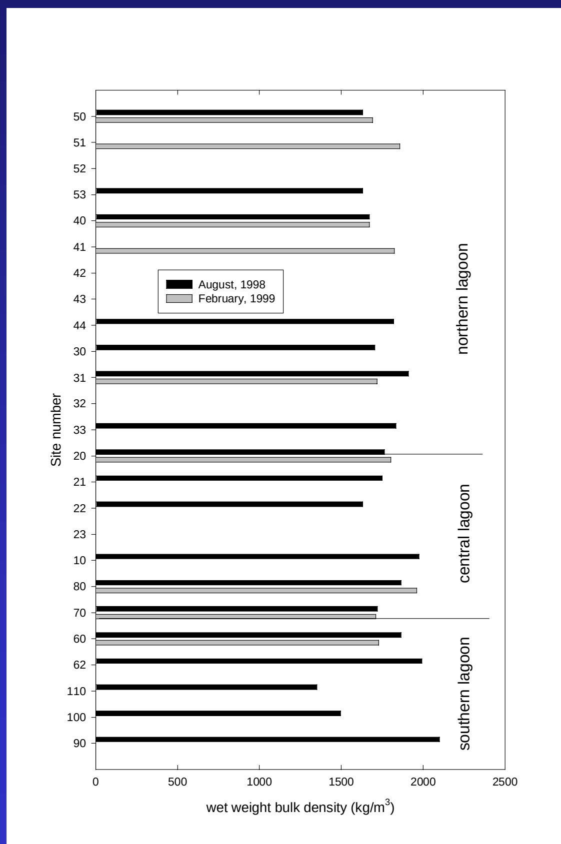
Southampton Oceanography Centre
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

Synthesis of input values for numerical simulation

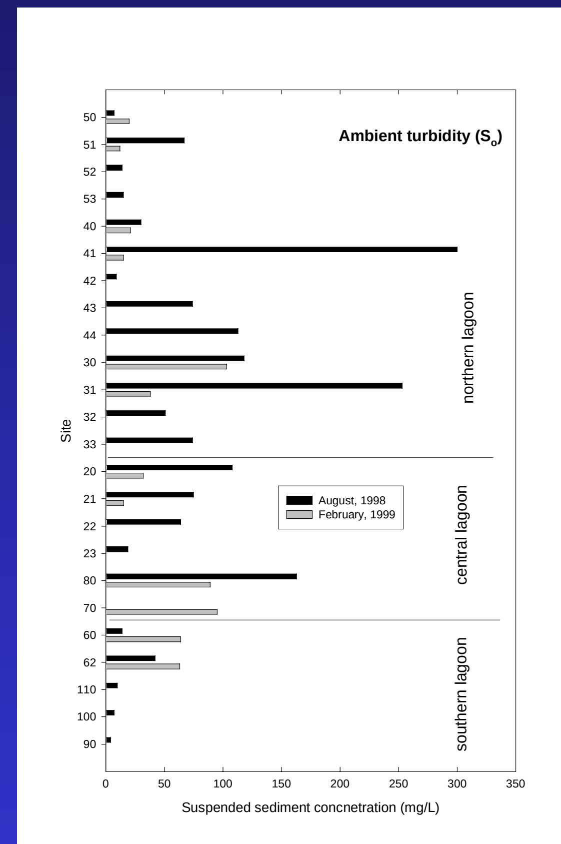




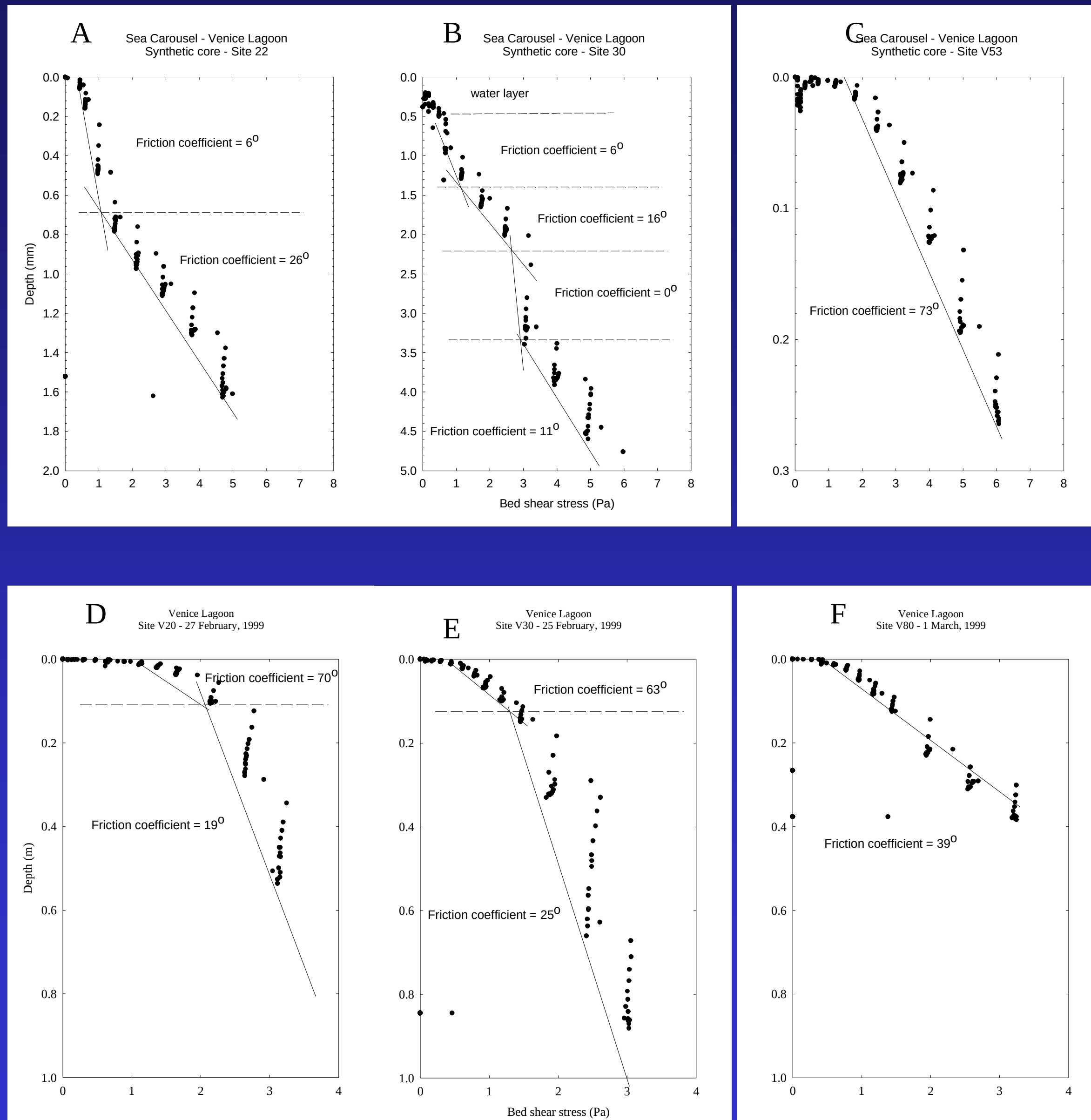




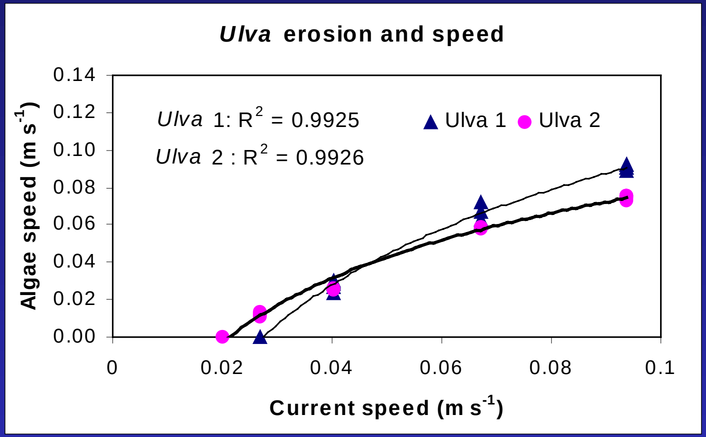
Site number
50
51
52
53
40
41
42
43
44
30
31
32
33
20
21
22
23
10
80
70
60
62
110
100
90
August, 1998
February, 1999
northern lagoon
central lagoon
southern lagoon
0
500
1000
1500
2000
2500
wet weight bulk density (kg/m3)

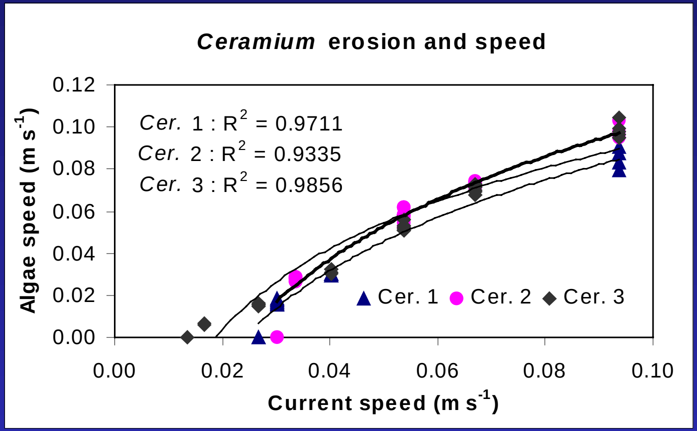


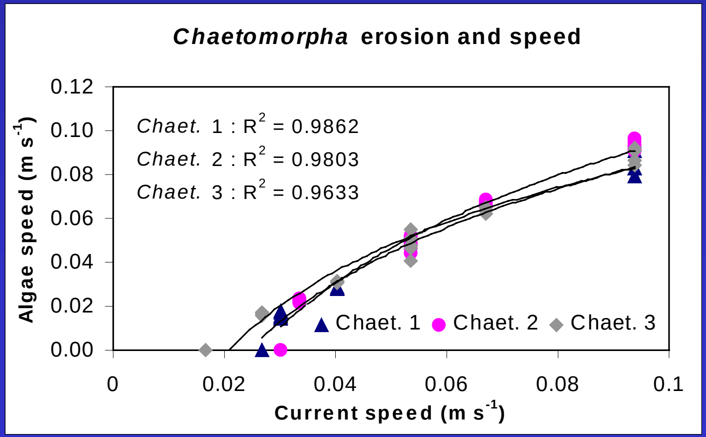
Ambient turbidity (So)
Site
50
51
52
53
40
41
42
43
44
30
31
32
33
20
21
22
23
80
70
60
62
110
100
90
August, 1998
February, 1999
northern lagoon
central lagoon
southern lagoon
0
50
100
150
200
250
300
350
Suspended sediment concnetration (mg/L)

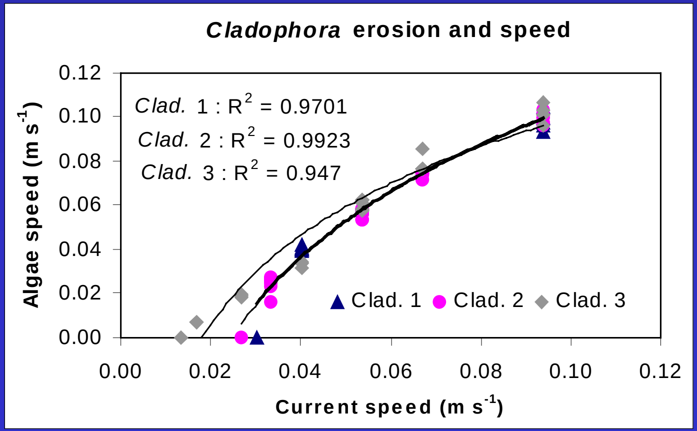

A
Sea Carousel - Venice Lagoon
Synthetic core - Site 22
Depth (mm)
Friction coefficient = 6°
Friction coefficient = 26°
B
Sea Carousel - Venice Lagoon
Synthetic core - Site 30
water layer
Friction coefficient = 6°
Friction coefficient = 16°
Friction coefficient = 0°
Friction coefficient = 11°
Bed shear stress (Pa)
C
Sea Carousel - Venice Lagoon
Synthetic core - Site V53
Friction coefficient = 73°
D
Venice Lagoon
Site V20 - 27 February, 1999
Depth (m)
Friction coefficient = 70°
Friction coefficient = 19°
E
Venice Lagoon
Site V30 - 25 February, 1999
Friction coefficient = 63°
Friction coefficient = 25°
Bed shear stress (Pa)
F
Venice Lagoon
Site V80 - 1 March, 1999
Friction coefficient = 39°

Algal mobilization and the solid-transmitted stress









Scouring and fronts - Treporti

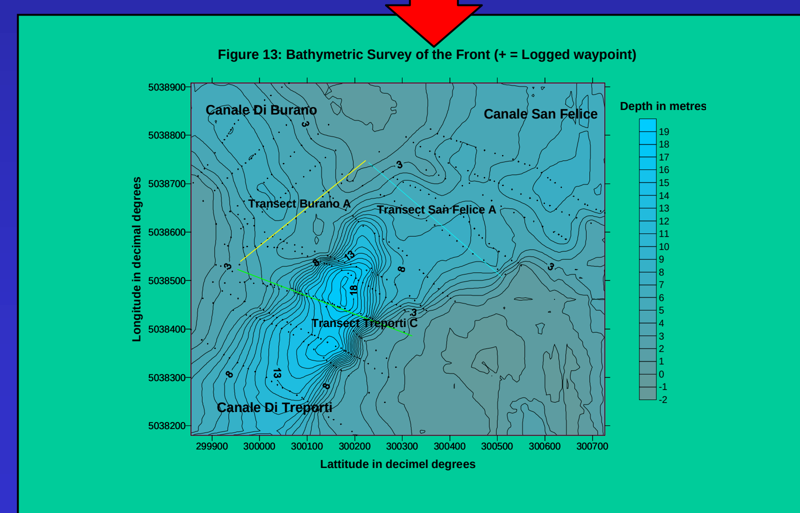
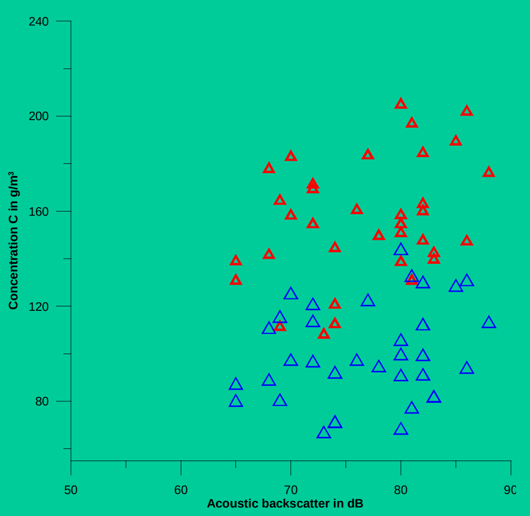


Figure 6: Graph Displaying the Concentrations of SPM and Suspended Sediments in relation to the Acoustic Backscatter levels



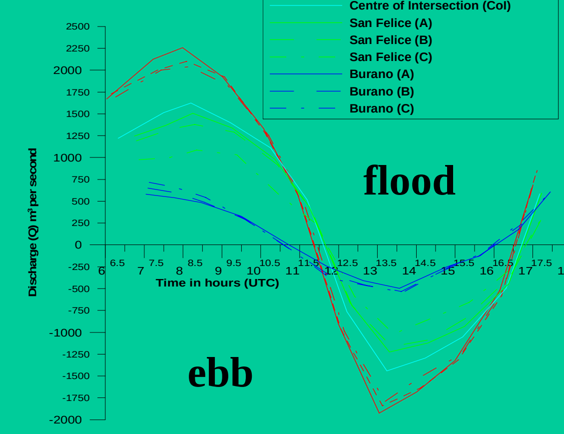
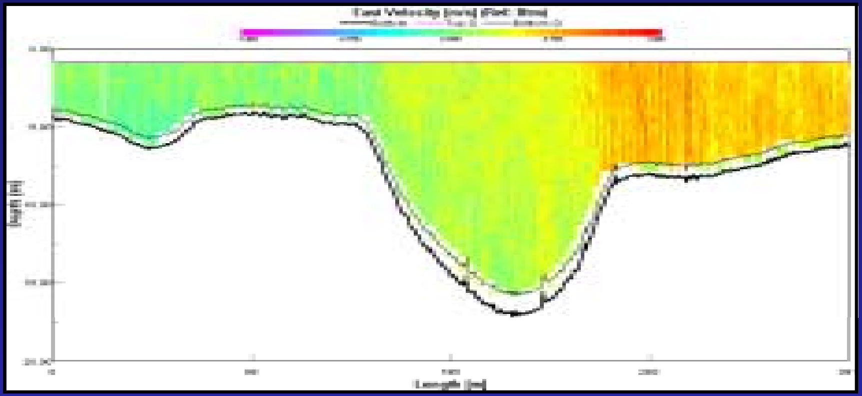


Figure 7: Comparative graph of the Discharge levels (Q) from the 10 transects as legend below:

Residual circulation and frontal analyses



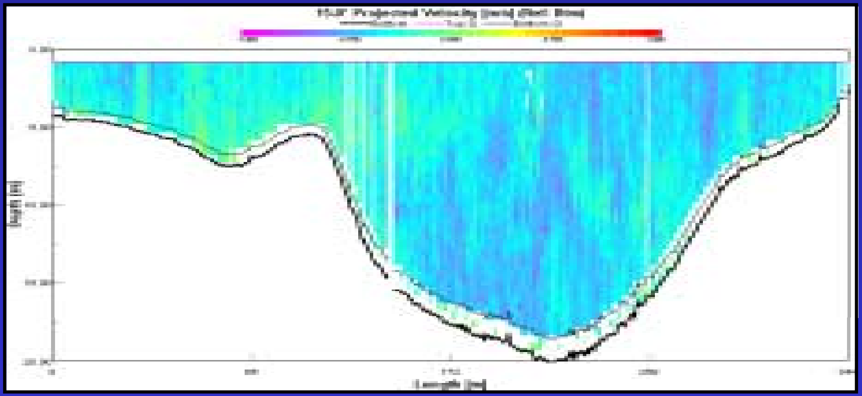
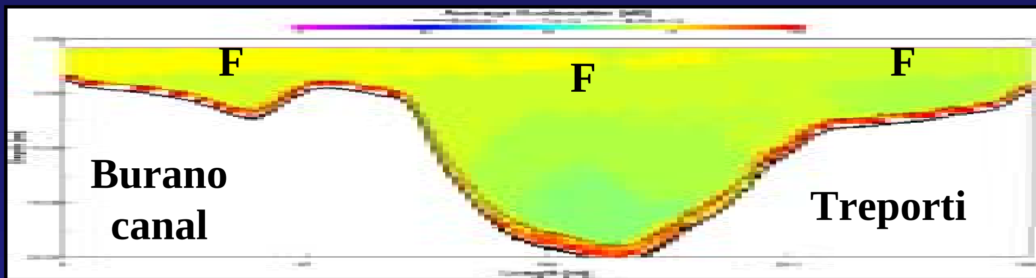


Table 2: Levels of Q averaged throughout the tidal cycle							
Treporti (C)		Centre of Intersection		San Felice (A)		Burano (A)	
Start time	Q Discharge (M³/s)	Start time	Q Disharge (M³/s)	Start time	Q Disharge ((M³/s)	Start time	Q Disharge (M³/s)
6.16	1692,57	6.20	1222,47	6.45	1248,47	7.03	581,58
7.26	2001,02	7.30	1513,23	7.33	1367,01	7.47	540,35
8.09	2041,09	8.12	1625,06	8.15	1505,7	8.28	486
9.08	1833,27	9.13	1401,43	9.16	1337,05	9.30	328,92
10.12	1255,55	10.15	1112,01	10.22	979,32	10.44	-1,55
11.06	501,31	11.12	513,88	11.15	436,43	11.42	-242,78
12.09	-986,96	12.13	-763,41	12.18	-665,04	12.38	-406,96
13.12	-1790,88	13.15	-1440,6	13.19	-1225,71	13.34	-496,93
14.10	-1495,24	14.14	-1295,35	14.18	-1121,26	14.47	-252,74
15.09	-1254,96	15.12	-1053,44	15.15	-931,51	15.36	-130,91
16.16	-494,12	16.19	-494,53	16.23	-444,25	16.38	177,53
17.07	856,18	17.11	583,43	17.14	591,45	17.27	607,2
Approx.	1400	Approx.	900	Approx.	900	Approx.	600
Σ of Flood Q	11580,99	Σ of Flood Q	8871,51	Σ of Flood Q	8365,43	Σ of Flood Q	3321,58
Ave.Σ of Flood Q	1447,6238	Ave.Σ of Flood Q	1108,93875	Ave.Σ of Flood Q	1045,67875	Ave.Σ of Flood Q	415,1975
Σ of Ebb Q	-6022,16	Σ of Ebb Q	-5047,33	Σ of Ebb Q	-4387,77	Σ of Ebb Q	-1110,01
Ave.Σ of Ebb Q	-1204,432	Ave.Σ of Ebb Q	-1009,466	Ave.Σ of Ebb Q	-877,554	Ave.Σ of Ebb Q	-222,002
Total discharge Q through flood (m³)	3,65E+07	Total discharge Q through flood (m³)	2,79E+07	Total discharge Q through flood (m³)	2,64E+07	Total discharge Q through flood (m³)	1,05E+07
Total discharge Q through ebb (m³)	-2,38E+07	Total discharge Q through ebb (m³)	-2,00E+07	Total discharge Q through ebb (m³)	-1,74E+07	Total discharge Q through ebb (m³)	-4,40E+06

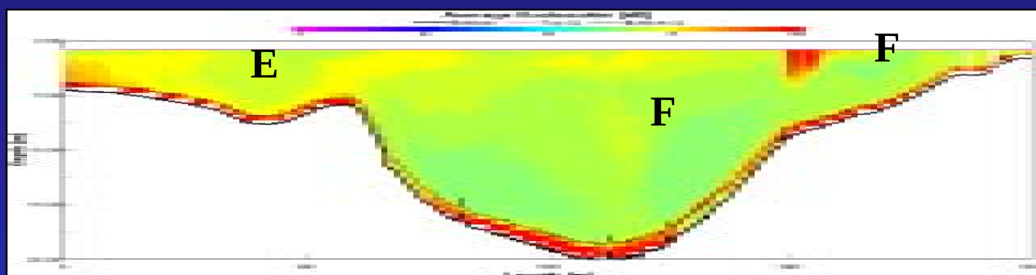
University of Southampton

CORILA

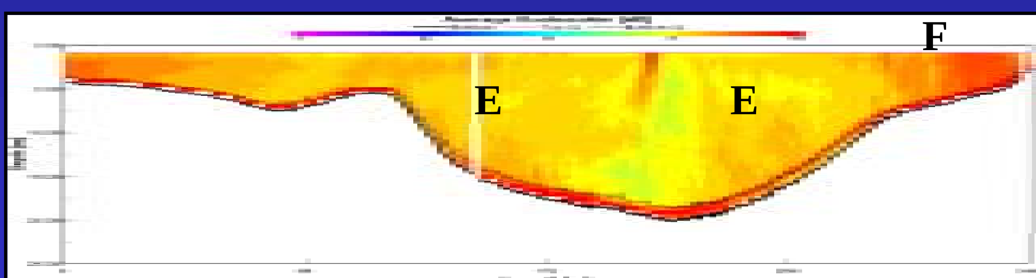
Southampton Oceanography Centre
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL



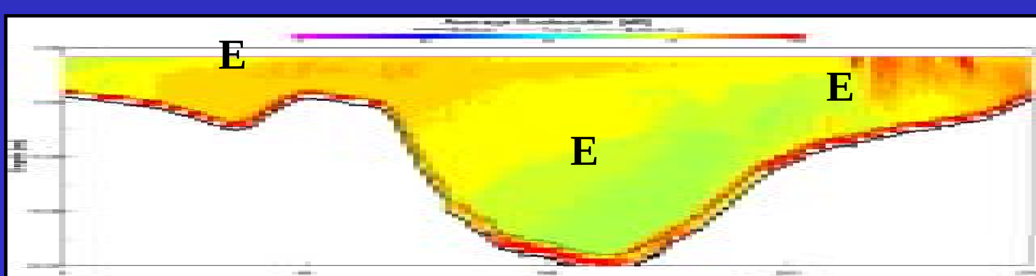
HT - 0.5 hours
high surface backscatter
abundant phytoplankton
low resuspension



HT + 0.5 hours
frontal mixing at scour centre
high shear Treporti/S. Felice
low resuspension



HT + 1 hour
strong frontal mixing over scour
resuspension in scour
resuspension at channel margins



Mid ebb
no front present
no resupension in scour
resuspension at channel margins

Sand transport - Lido entrance

★ **bottom sediment samples**
- composition (carbonate)
- granulometry & texture
- settling velocity

ADCP survey of inner Lido
- velocity structure
- backscatter (sand suspension)
- input to SEDTRANS

Sidescan mosaic of Lido canal
- bedform zonation (6 zones)
- bathymetry of outer canal