ICES/PICES 6th Zooplankton Production Symposium "New Challenges in a Changing Ocean"
9-13 May 2016, Bergen, Norway

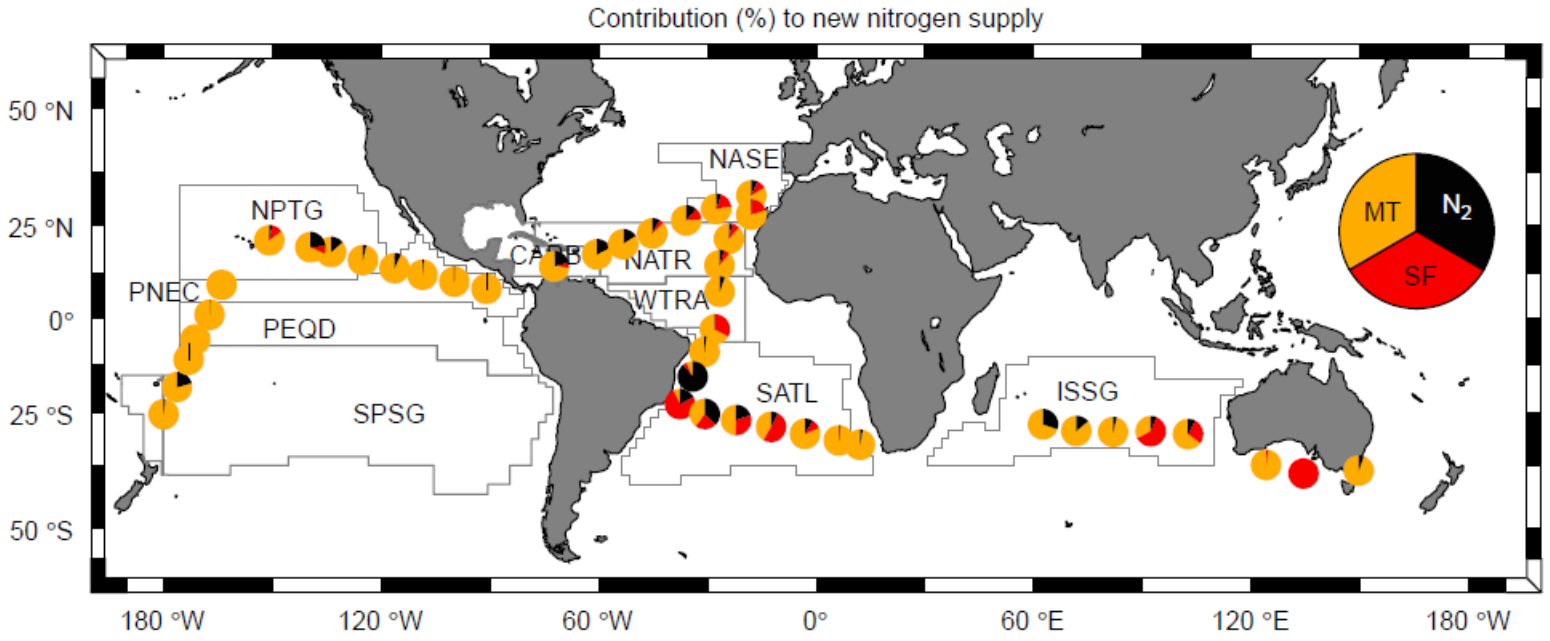
Amino acid stable N isotope estimations reveal uniform diazotrophic contributions across zooplankton size fractions in the subtropical N Atlantic*

Carmen Mompeán, **Antonio Bode**, Elizabeth Gier, Matthew D. McCarthy

* Published version now available: Mompeán, C., Bode, A., Gier, E., McCarthy, M.D., 2016. Bulk vs. aminoacid stable N isotope estimations of metabolic status and contributions of nitrogen fixation to size-fractionated zooplankton biomass in the subtropical N Atlantic. Deep Sea Res, doi:10.1016/j.dsr.2016.05.005.

Introduction

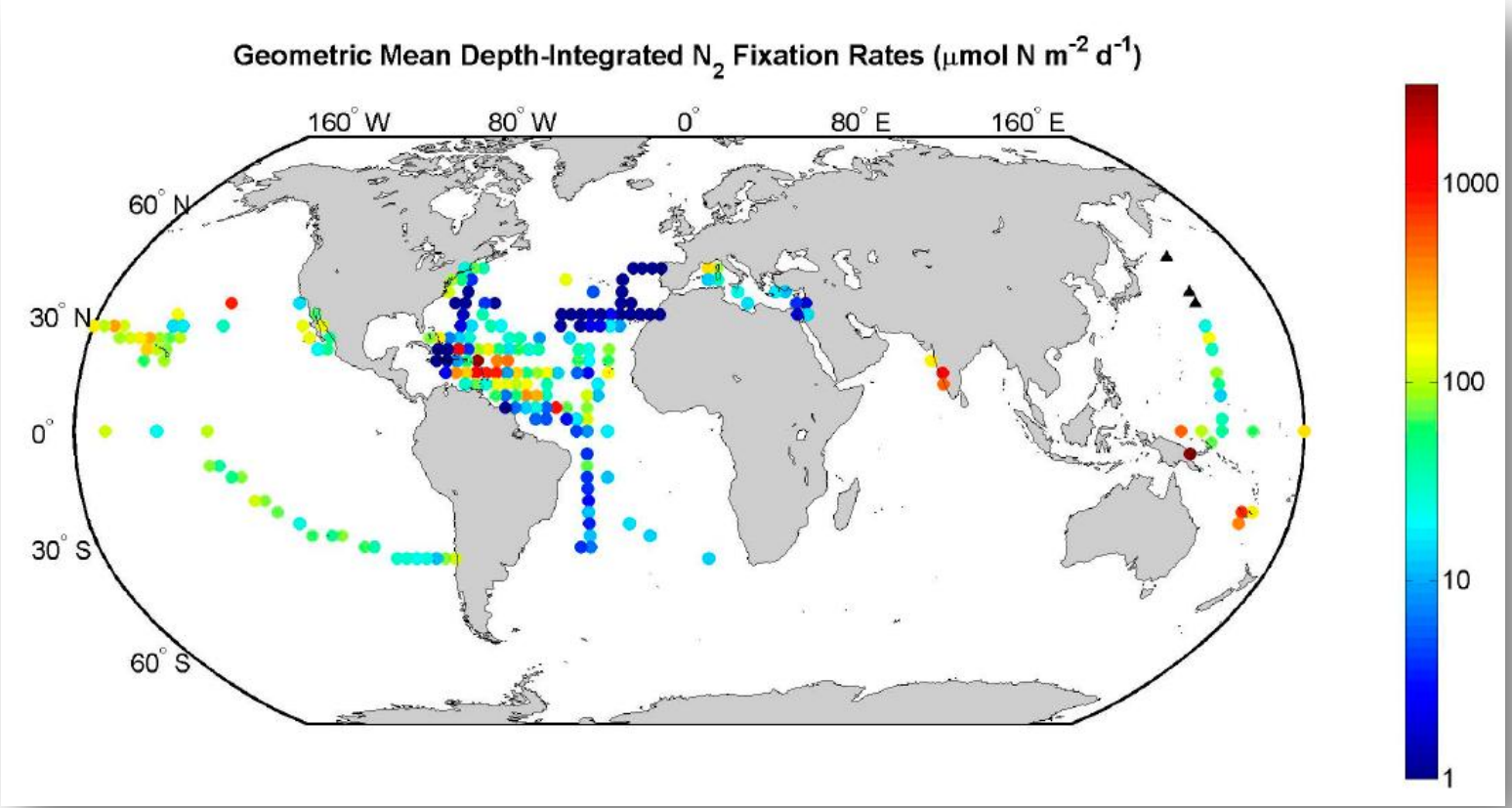
Nitrogen inputs to the upper ocean :



Fernández-Castro et al. (2015) Nature Comm 6, doi:10.1038/ncomms9002

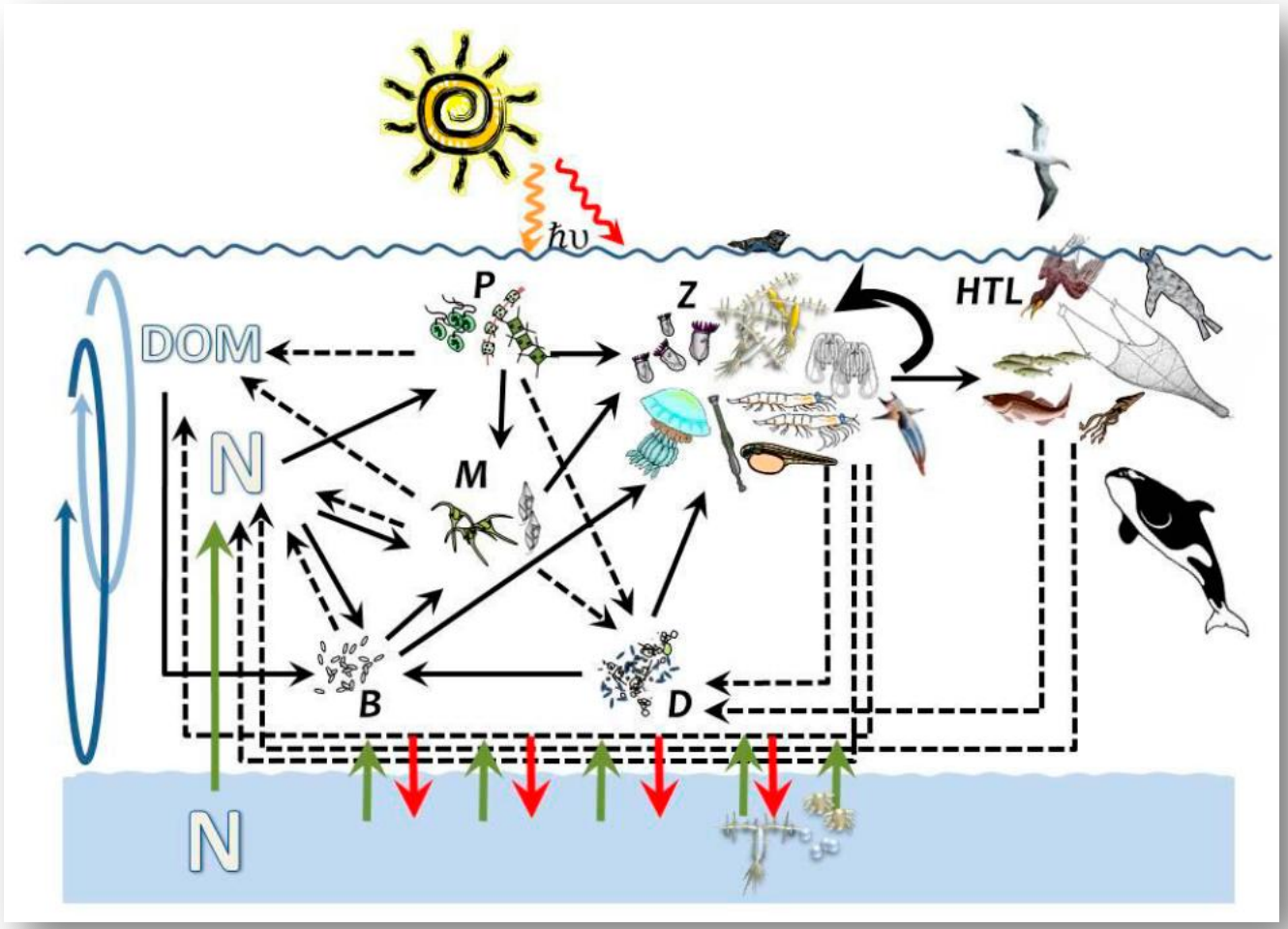
Introduction

Nitrogen fixation:



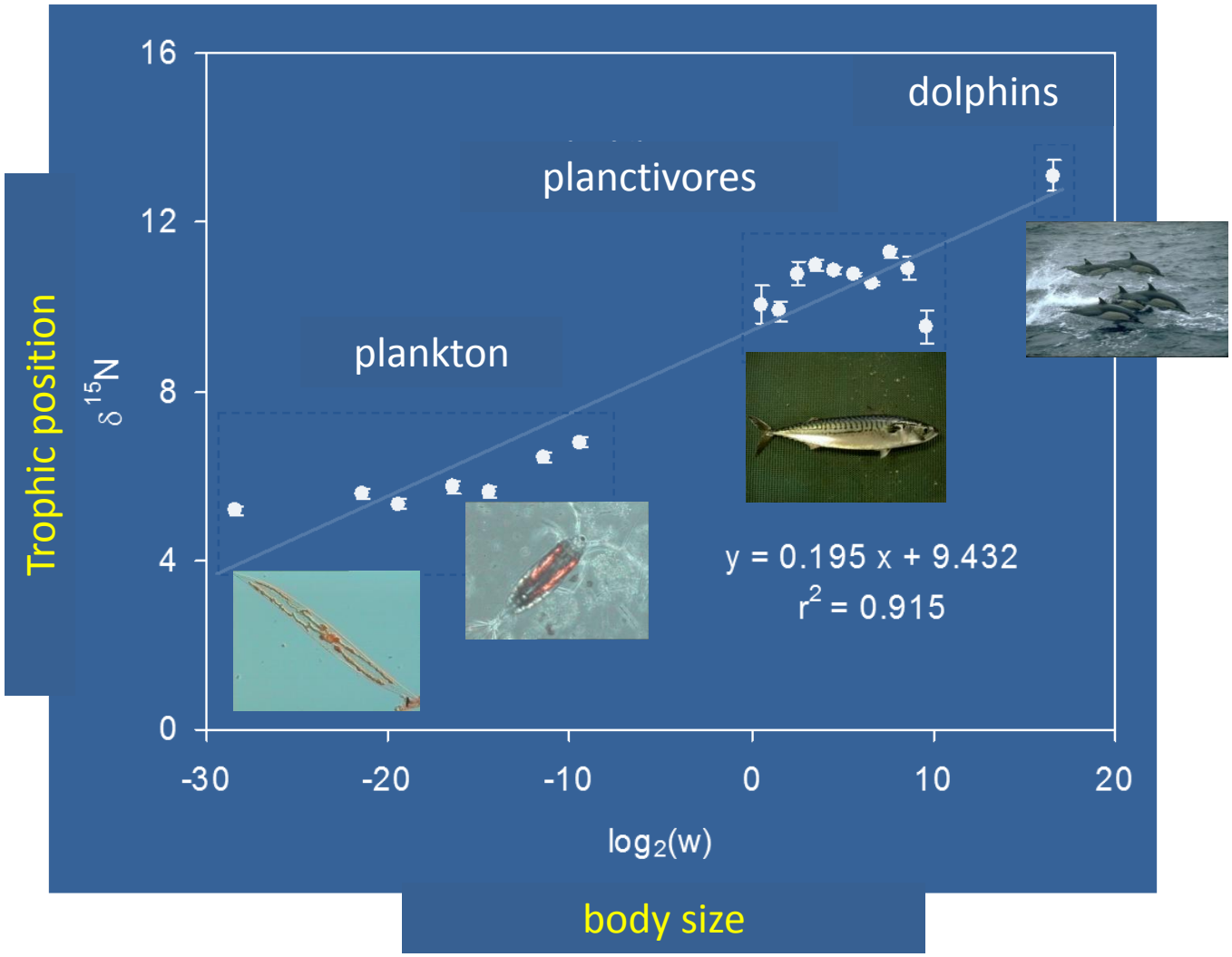
Luo et al. (2012) Earth Syst Sci Data 4: 47-73

Nitrogen transfer up the food web:



Mitra et al. (2014) Prog Oceanogr 129:176-199

Trophic structure:



Bode et al. (2003) ICES J Mar Sci 60:11-22

Estimating Trophic Positions:

TP_c

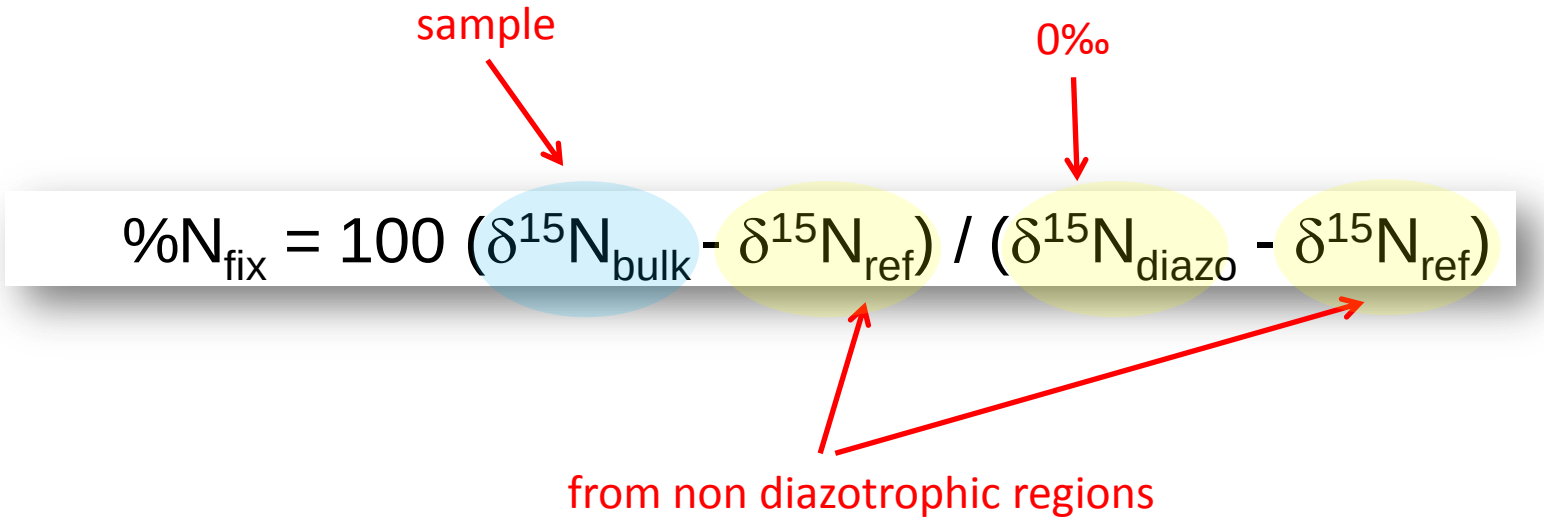
TEF

$$TL_{bulk} = (\delta^{15}N_{consumer} - \delta^{15}N_{producer})/3.4 + 1$$

- Variable TEF (species, physiology, trophic ecology,...)
- Variable $\delta^{15}N$ baseline from primary or secondary producers (N sources, physiology, omnivory…)

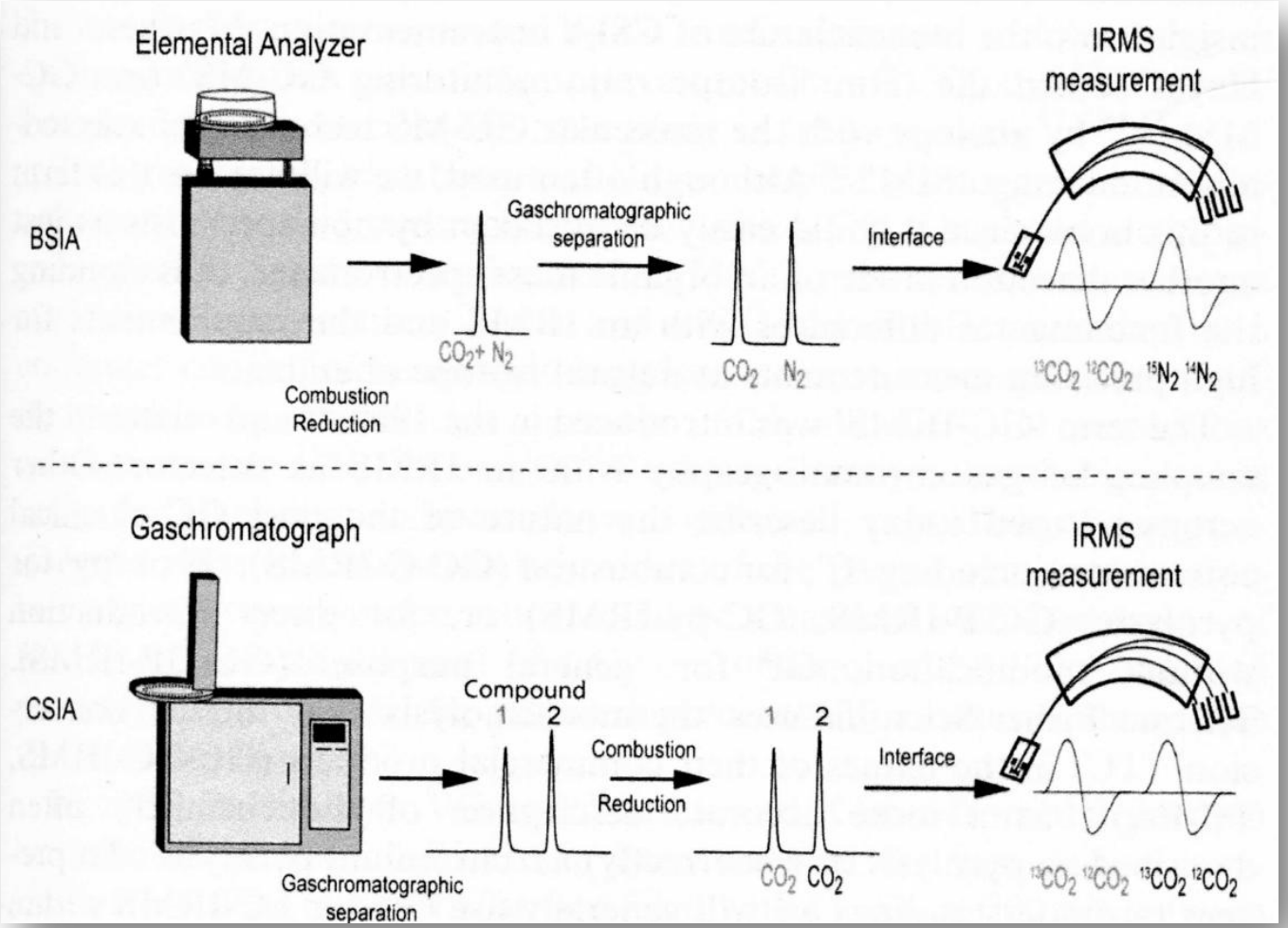
Post 2002, Ecology 83: 703-718

Estimating diazotrophic N:



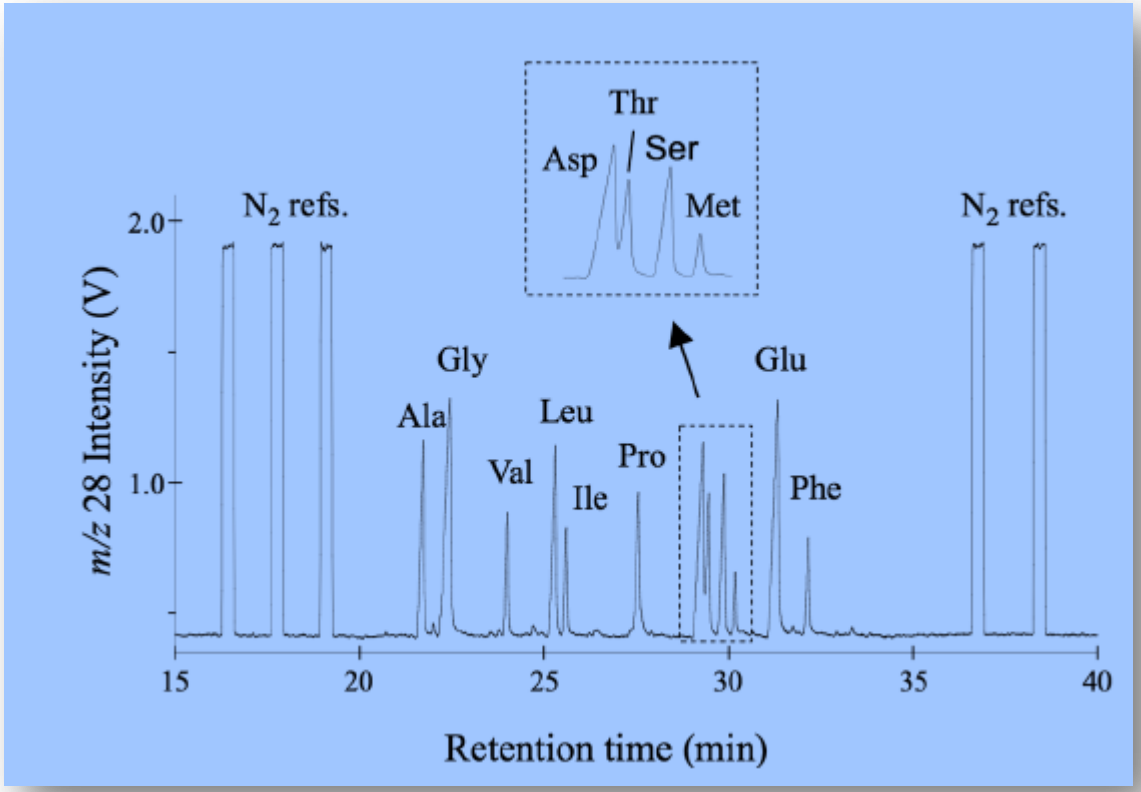
Montoya et al. 2002, Limnol. Ocanogr. 47: 1617-1628

Bulk Stable Isotope Analysis (BSIA) vs. Compound Specific Isotope Analysis (CSIA):



Jochmann & Schmidt (2012)

Introduction

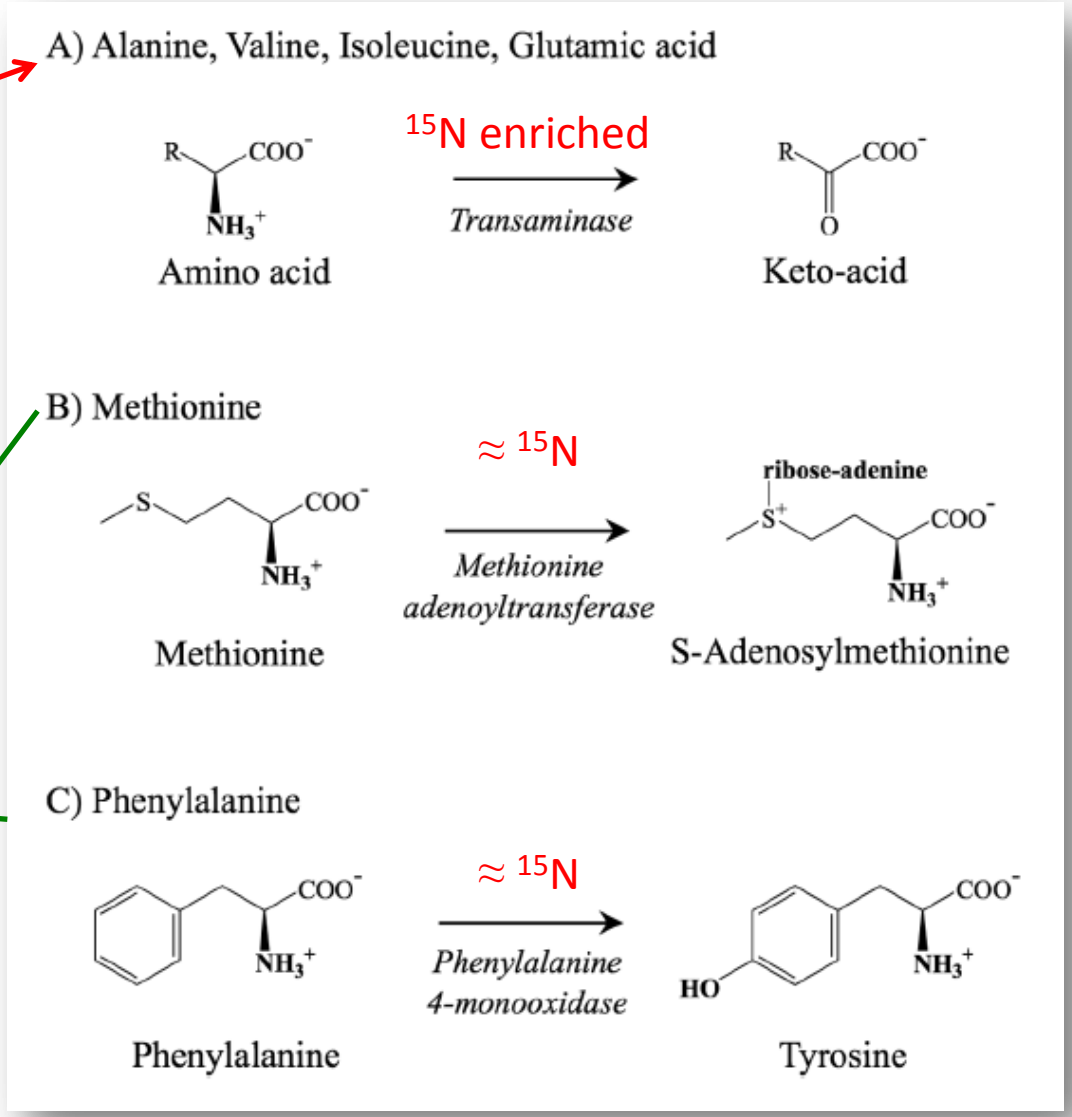


Chikaraishi et al. (2009) Limnol Oceanogr Methods 7:740-750

trophic vs. source AA

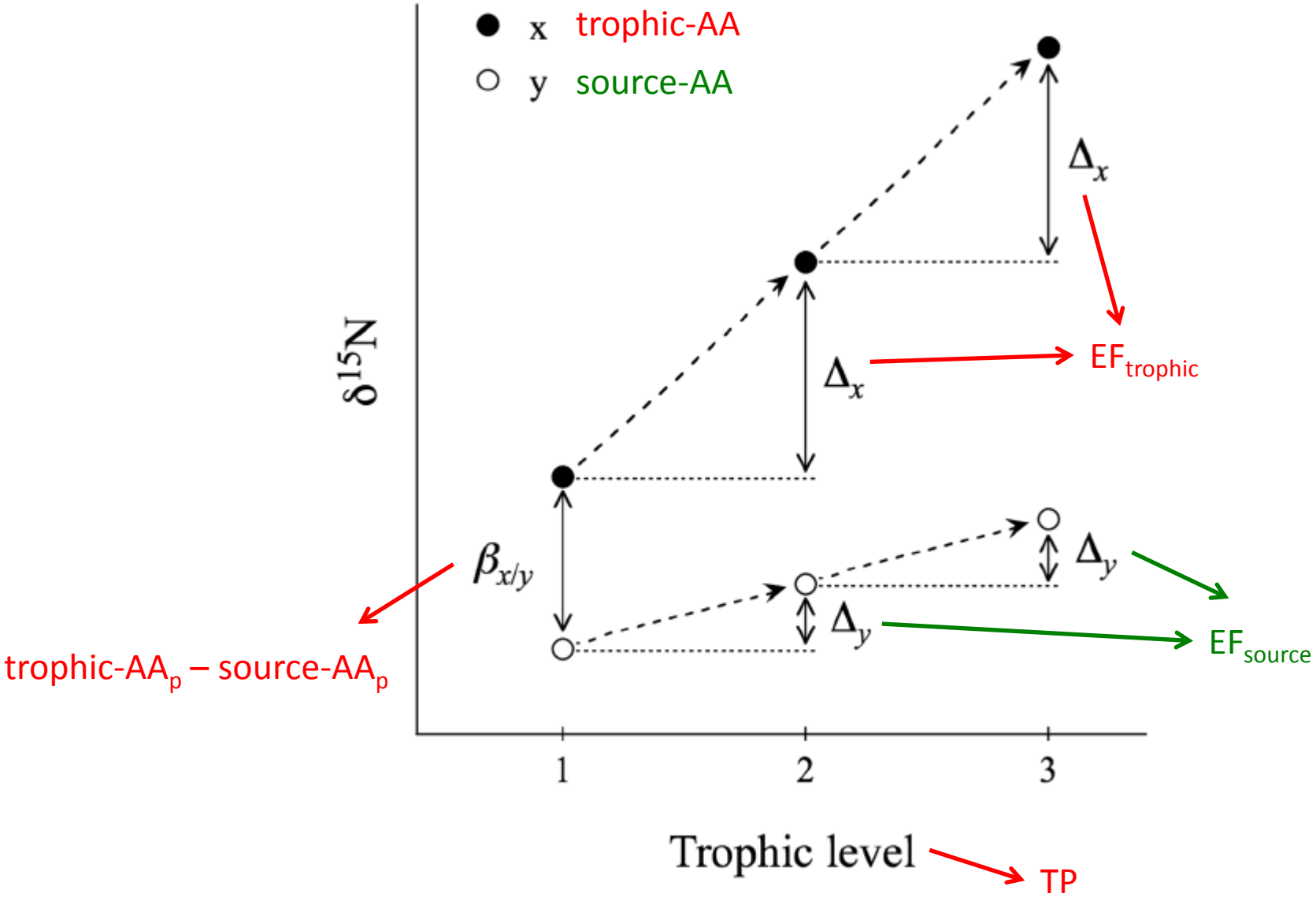
trophic-AA

source-AA



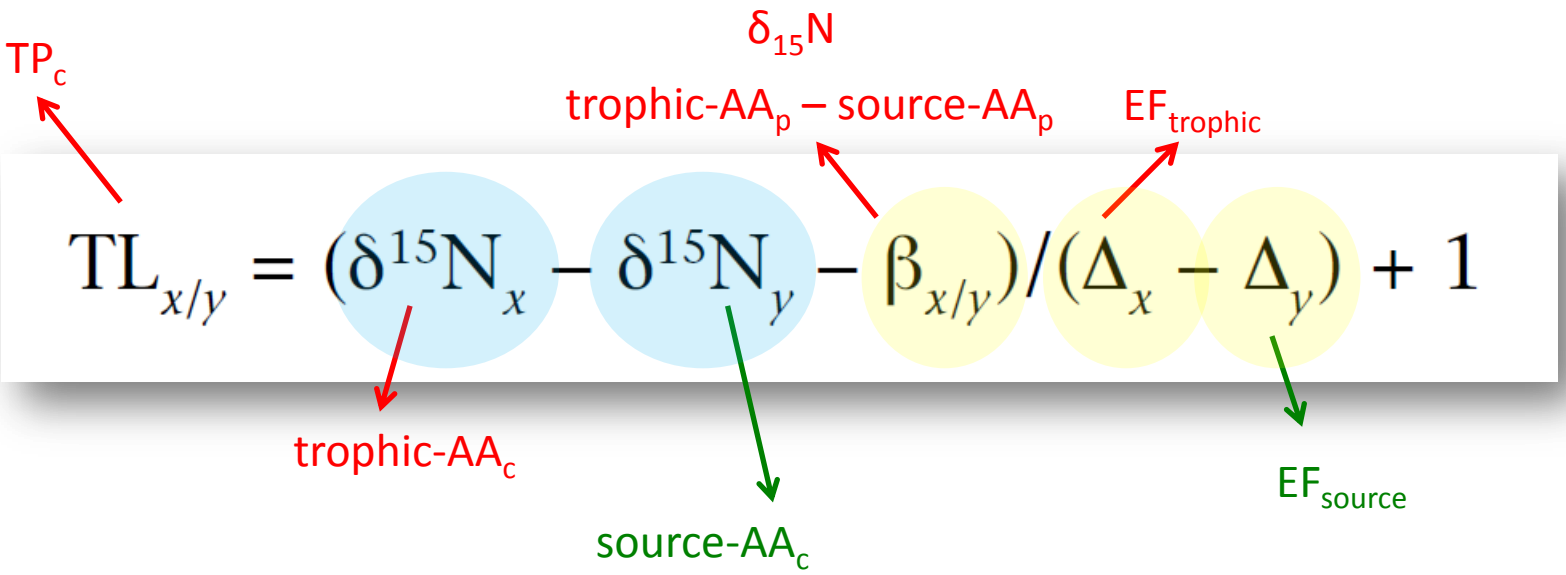
Chikaraishi et al. (2009) Limnol Oceanogr Methods 7:740-750

Differences in $\delta^{15}N$ AA-enrichment



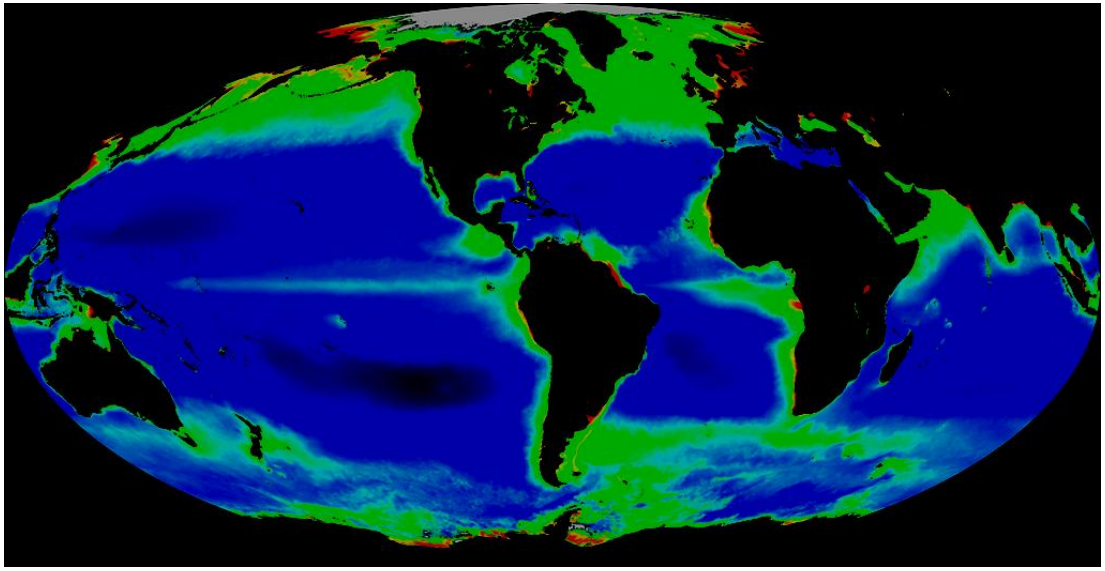
Chikaraishi et al. (2009) Limnol Oceanogr Methods 7:740-750

Estimation of trophic position from AA-$\delta^{15}N$:



Chikaraishi et al. (2009) Limnol Oceanogr Methods 7:740-750

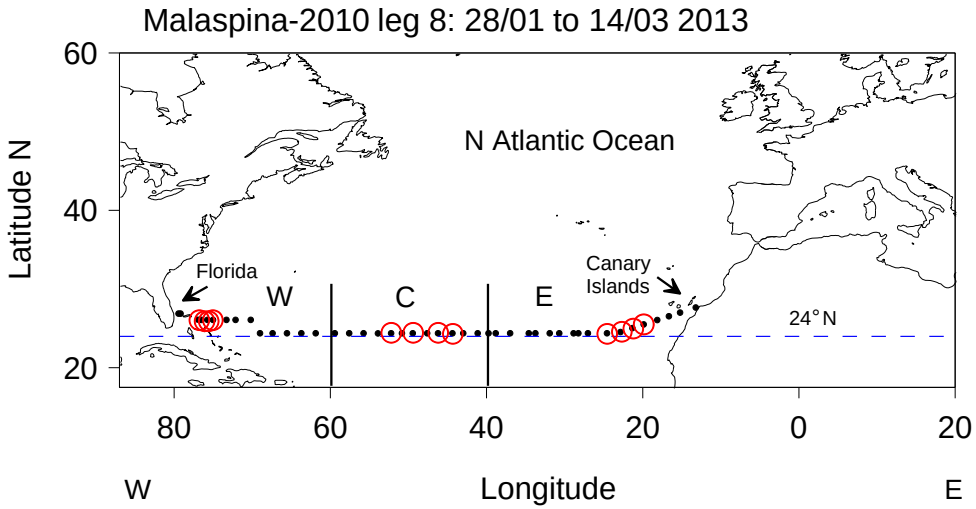
Objective



NASA SeaWifs

Methods

Sampling

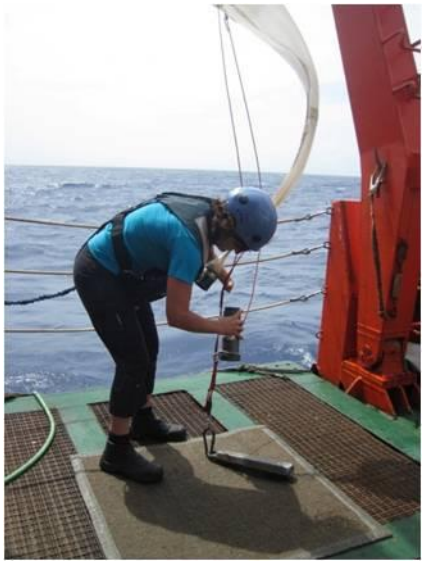


Circunnavigation Expedition Malaspina 2010: Global Change and Biodiversity Exploration of the Global Ocean (MALASPINA 2010). Project CSD 2008-00077

Methods

Sample processing:

WP2 nets
40 & 200µm mesh
0-200m



Separation in size-fractions

Size-fractions :
40-200µm
200-500µm
500-1000µm
1000-2000µm
2000-5000µm

SINAR
(mass-spectrometry)

$\delta^{15}N$ (‰)

Methods

Estimating diazotrophic N:

nitrate 5‰ | atmospheric N_2 0‰ | nitrate 5‰

$$\%N_{fix} = 100 (\delta^{15}N_{bulk} - \delta^{15}N_{ref}) / (\delta^{15}N_{diazo} - \delta^{15}N_{ref})$$

Montoya et al. 2002, Limnol. Ocanogr. 47: 1617-1628

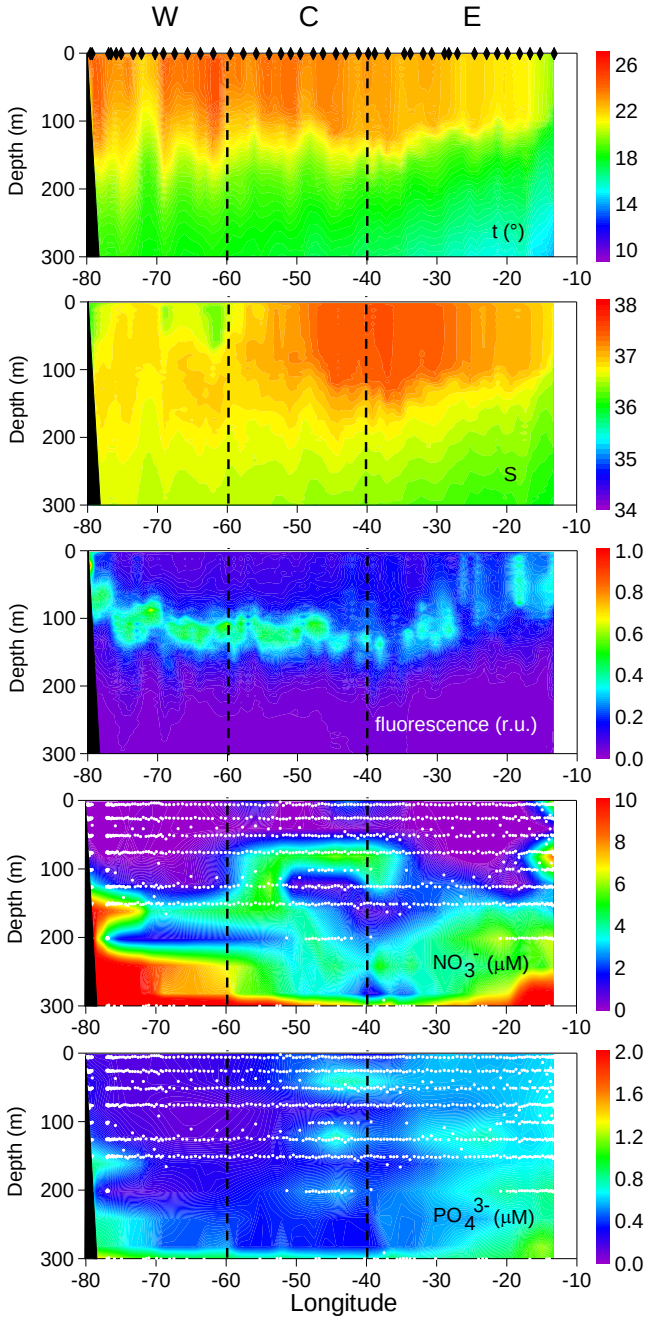
$$\delta^{15}N_{bulk} = \delta^{15}N_{Phe} + \beta_{Phe}$$

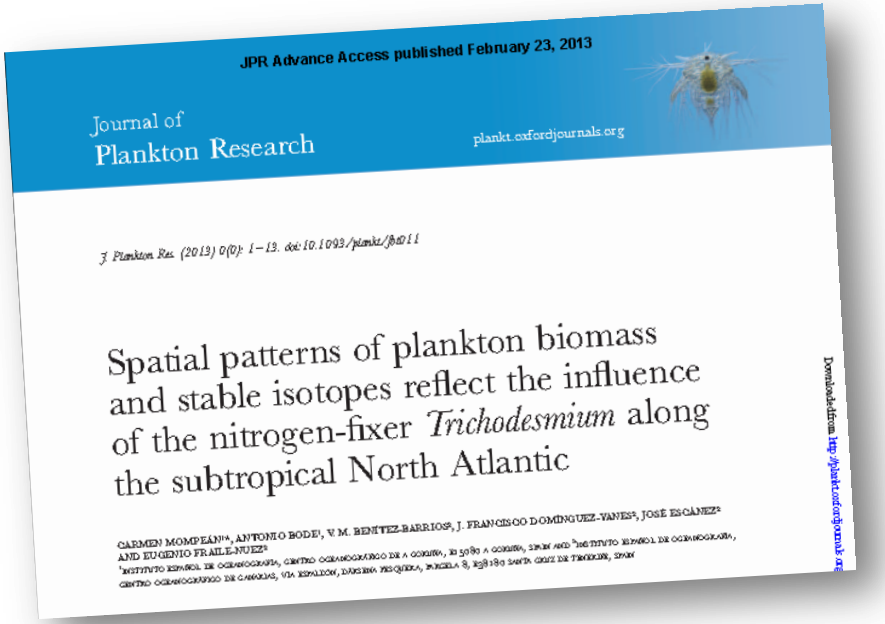
Estimating TP using δ^{15}N Glu & Phe:

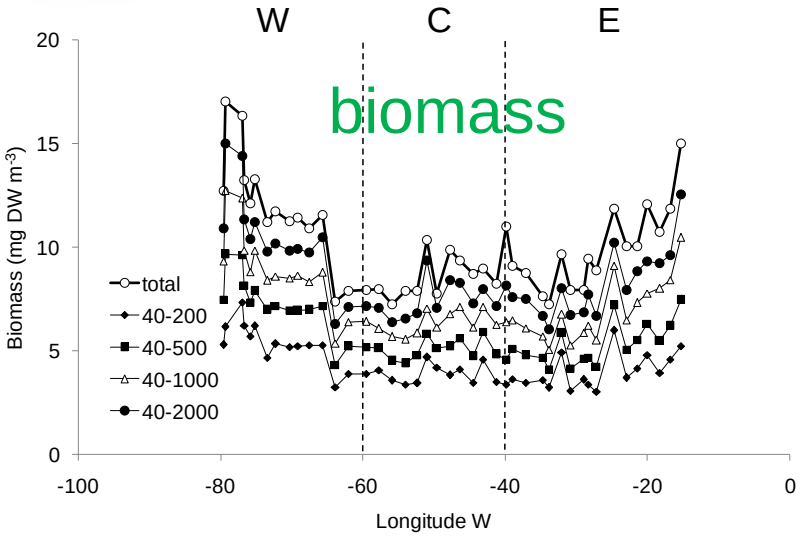
$$TL_{Glu/Phe} = (\delta^{15}N_{Glu} - \delta^{15}N_{Phe} - 3.4)/7.6 + 1$$

Chikaraishi et al. (2009) Limnol Oceanogr Methods 7:740-750

Results

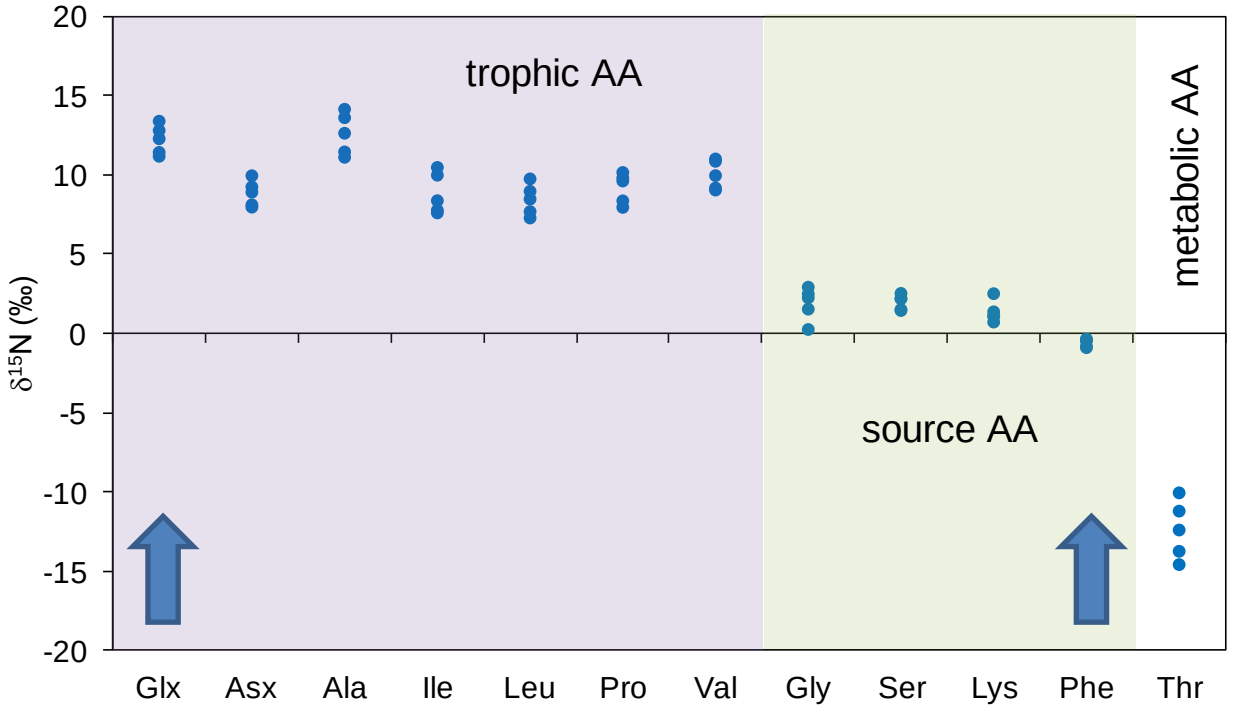




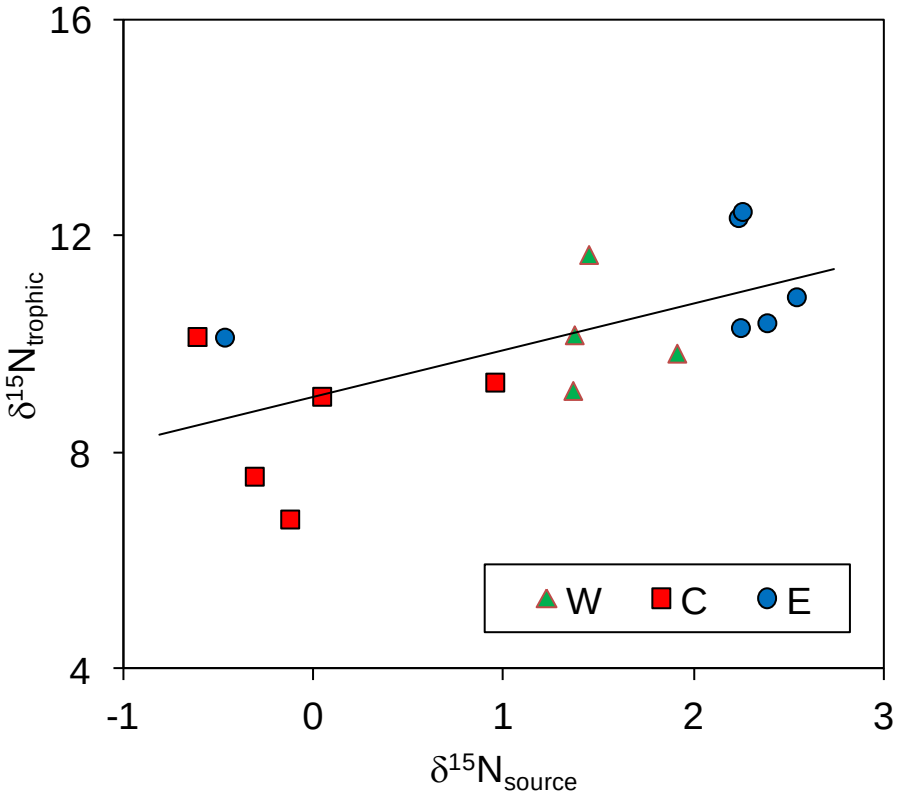


© Mompeán et al., J. Plankton Res. 2013, doi:10.1093/plankt/fbt011

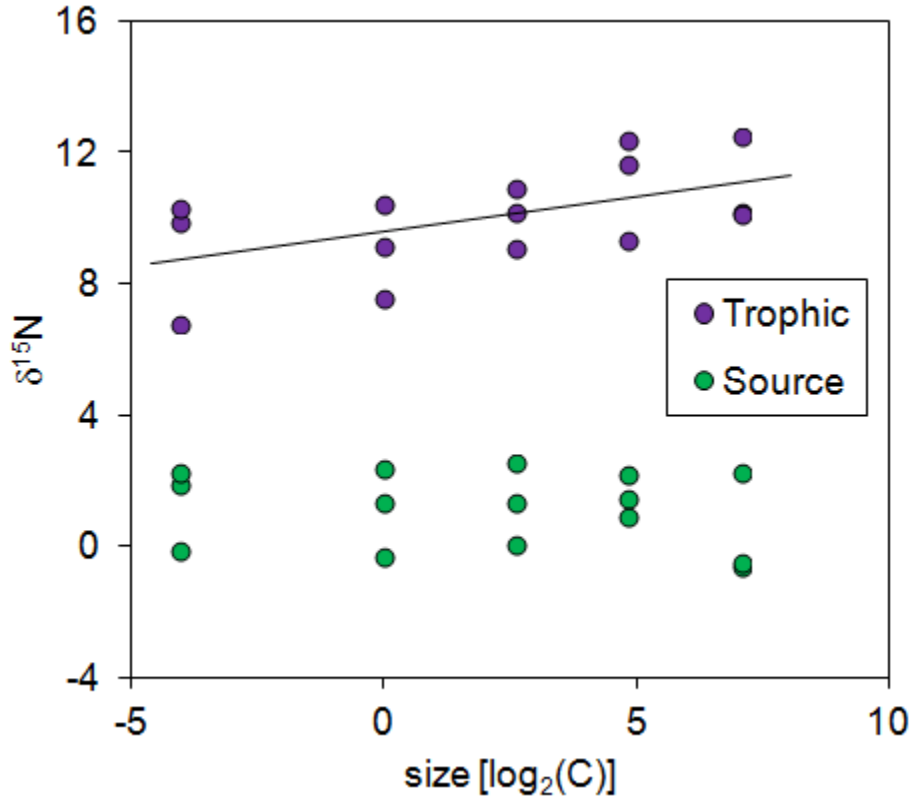
Results


trophic AA
source AA
metabolic AA
δ15N (‰)
20
15
10
5
0
-5
-10
-15
-20
Glx
Asx
Ala
Ile
Leu
Pro
Val
Gly
Ser
Lys
Phe
Thr

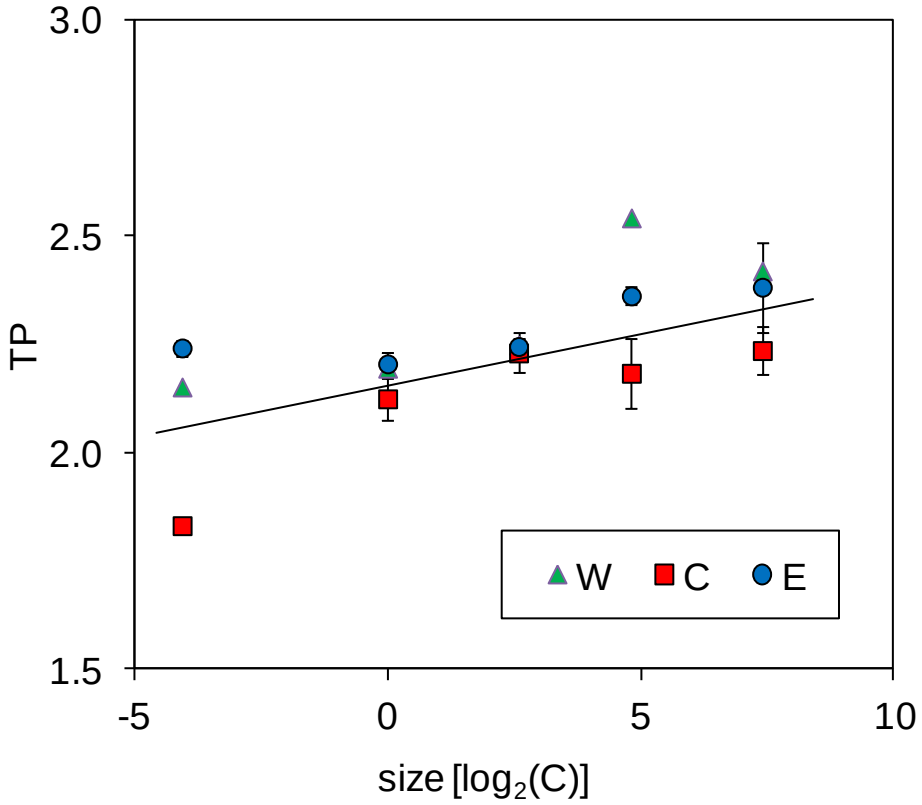
Results



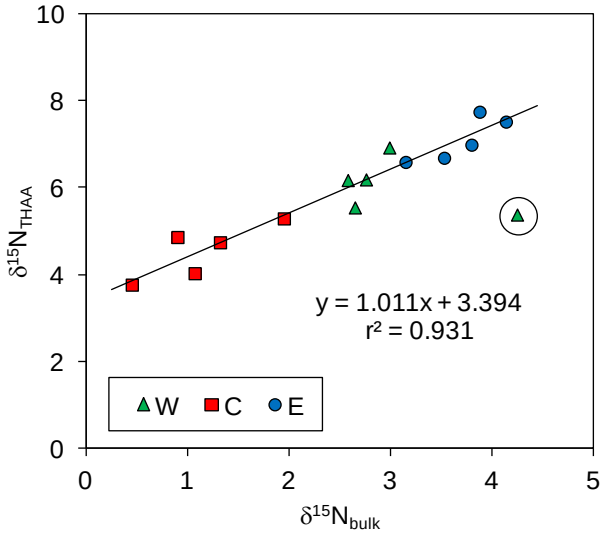
Results

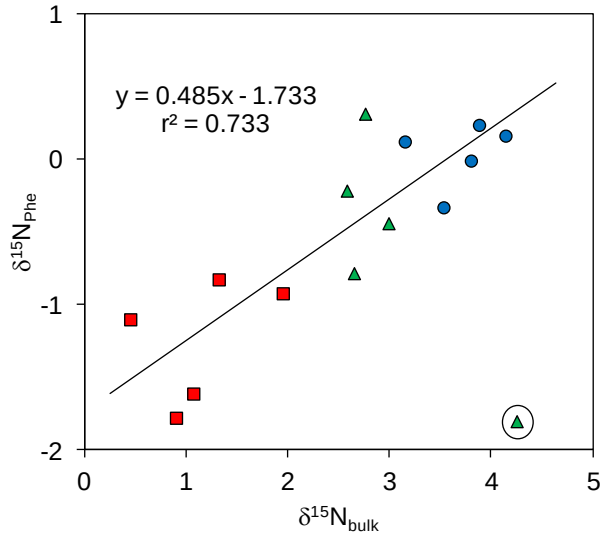


Results

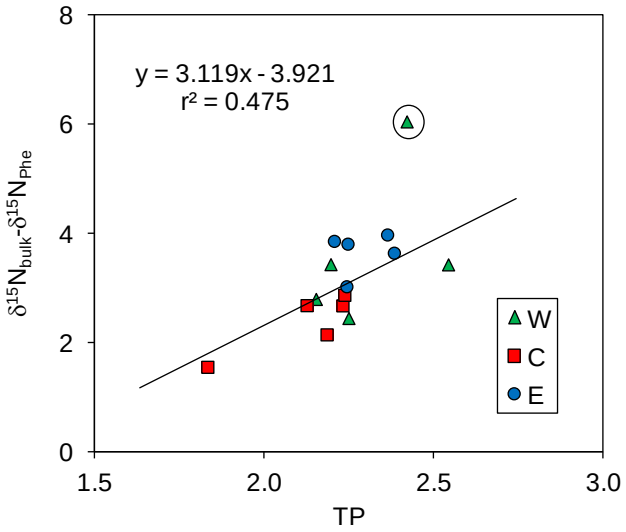


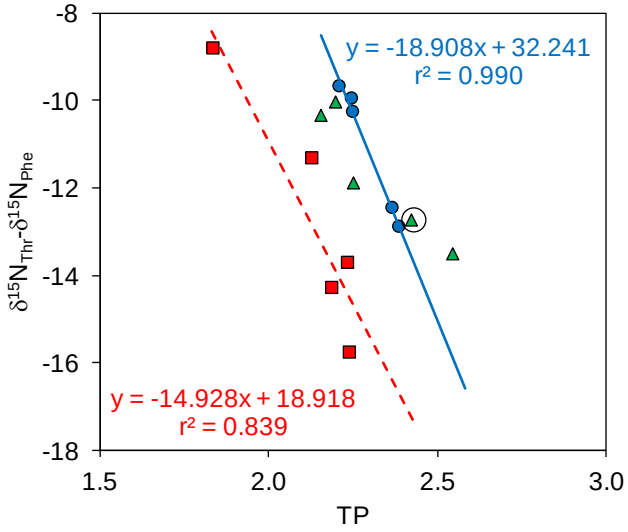
Results


y = 1.011x + 3.394
r² = 0.931
W
C
E
δ15NTHAA
δ15Nbulk

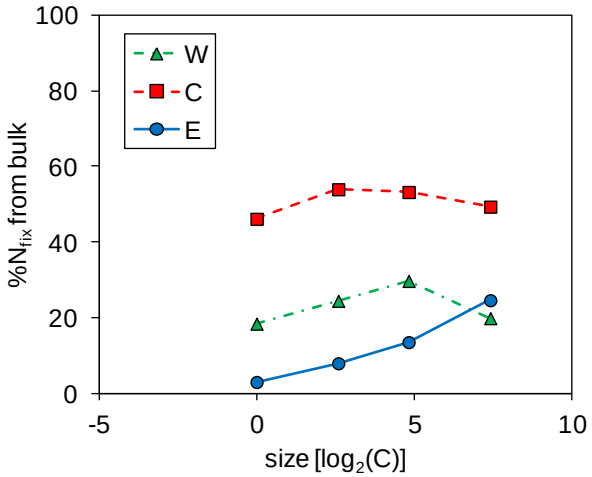

y = 0.485x - 1.733
r² = 0.733
δ15NPhe
δ15Nbulk

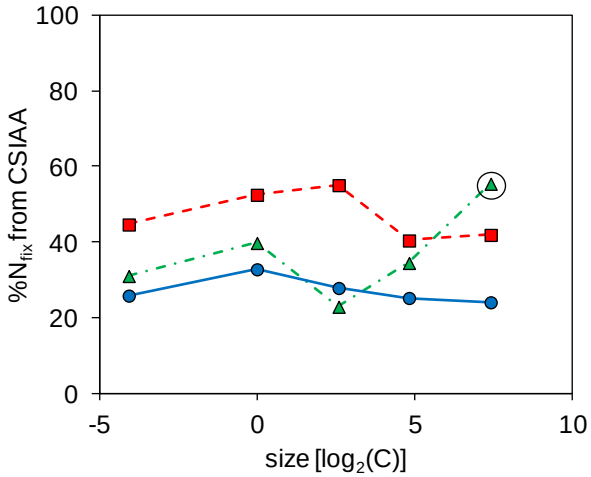
Results


y = 3.119x - 3.921
r² = 0.475
W
C
E
δ15Nbulk-δ15NPhe
TP
8
6
4
2
0
1.5
2.0
2.5
3.0

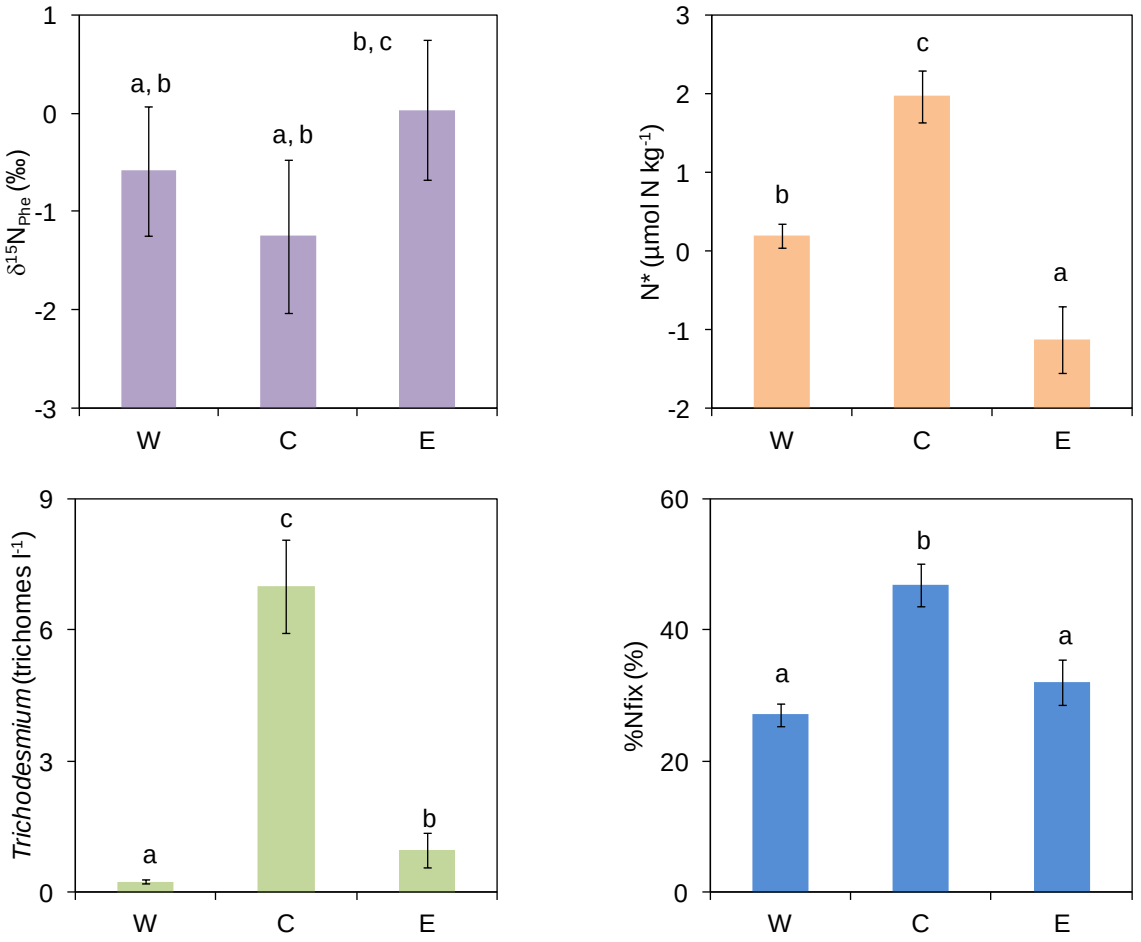

y = -18.908x + 32.241
r² = 0.990
y = -14.928x + 18.918
r² = 0.839
δ15NThr-δ15NPhe
TP
-8
-10
-12
-14
-16
-18
1.5
2.0
2.5
3.0

Results


100
80
60
40
20
0
%N$_{fix}$ from bulk
W
C
E
-5
0
5
10
size [log$_2$(C)]


100
80
60
40
20
0
%N$_{fix}$ from CSIAA
-5
0
5
10
size [log$_2$(C)]

Results


1
0
-1
-2
-3
$\delta^{15}N_{Phe}$ (‰)
a, b
a, b
b, c
W
C
E
3
2
1
0
-1
-2
N* (µmol N kg^{-1})
b
c
a
W
C
E
9
6
3
0
Trichodesmium (trichomes l^{-1})
a
c
b
W
C
E
60
40
20
0
%Nfix (%)
a
b
a
W
C
E

Conclusions


CORREOS
0,50€ España
BIODIVERSIDAD Y OCEANOGRAFÍA
EXPEDICIÓN MALASPINA 2010
MALASPINA
MICROPLANCTON> 20µm
Formol 4%
RCM-FNMT 2011
ESTUDIO JESUS SANCHEZ