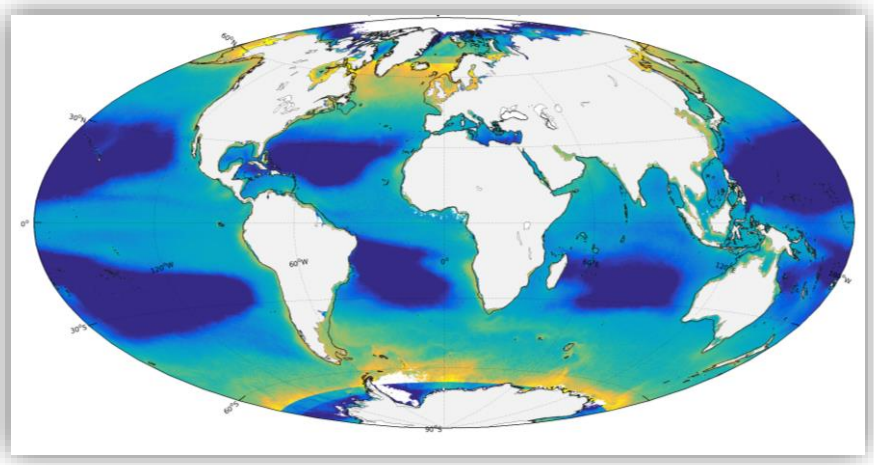
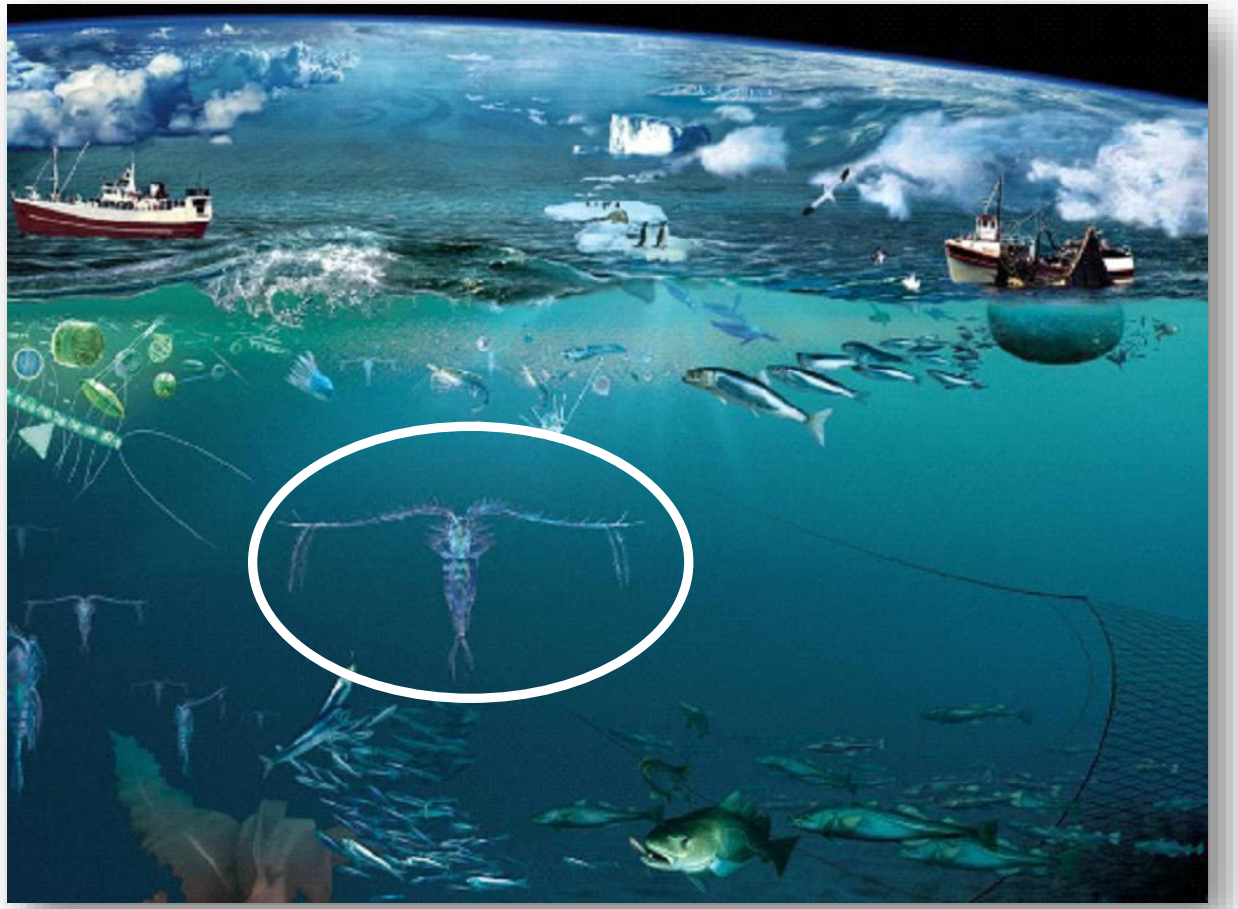
Satellite-based assessment of marine food web productivity in European Seas (Ocean Productivity index for Fish - OPFish)





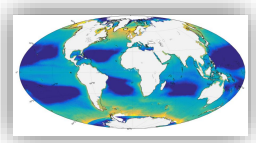
Jean-Noël Druon et al….

Joint Research Centre,

European Commission

OPFish workshop, May 2019

OPFish workshop participants
Ispra, Italy May 27-28th 2019



JRC – Unit D.02:

- Jean-Noël Druon
- Jann Martinsohn
- Alessandro Mannini (Tuesday)
- Cecilia Pinto
- Chiara Piroddi
- Antonella Zanzi
- Paris Vasilakopoulos
- Andreas Palialexis
- Maurizio Gibin

Documents' review:

- (Christoph Konrad)
- (Diego Macias)

European experts:

- Didier Gascuel, AGROCAMPUS OUEST
- Francesco Colloca, CNR
- Laurent Dubroca IFREMER Port en Bessin
- Natalia Serpetti, Scottish Marine Institute
- Joanna Bluemel, CEFAS
- Jeroen Steenbeek, Ecopath International Initiative Research Association

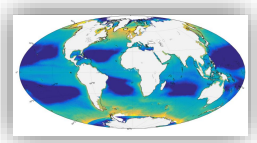
Video-Conference

- Verena Trenkel, IFREMER Nantes

Documents' review:

- Jean-Marc Fromentin, IFREMER Sète
- Marta Coll, ICM-CSIC Barcelona
- Brian Mackenzie, DTU-Aqua
- Mark Payne, DTU-AQUA
- Pierre Hélaouët, MBA
- Christopher Lynam, CEFAS

OPFish workshop
Ispra, Italy May 27-28th 2019



Objectives:
- to collect feedback from fisheries scientists and ecosystem modellers on these data comparisons on fisheries and environment,
- to guide on further improvements/analysis/methods (bias, limitations)
- to advise on potential uses in monitoring, management, research, policy,
- to identify what to publish and in which journal.

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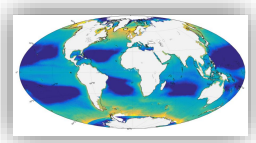
OPFish workshop
Ispra, Italy May 27-28th 2019



Agenda (9.00-17.30):

Half-day 1: Species habitat & OPFish method and results
Half-day 2: Comparison with Fisheries Dependent Data (LPUEs): DCF-ICES WGSFD
Half-day 3: Comparison with Scientific surveys: MEDITS & DATRAS
Half-day 4: Further analysis, improvements, limits, uses, publication(s)

Social diner tonight: pick-up at the hotel at 19.30 – who's coming?

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The OPFish and habitat method

Most of the **food source for high trophic levels is originating from zooplankton,**

- **Zooplankton is the main bottleneck of** marine ecosystem **knowledge.**
- Zooplankton dynamics is difficult to capture, yet essential for the assessment of HTLs.

✓ Links were found between zooplankton/HTL distribution and chlorophyll-a fronts.

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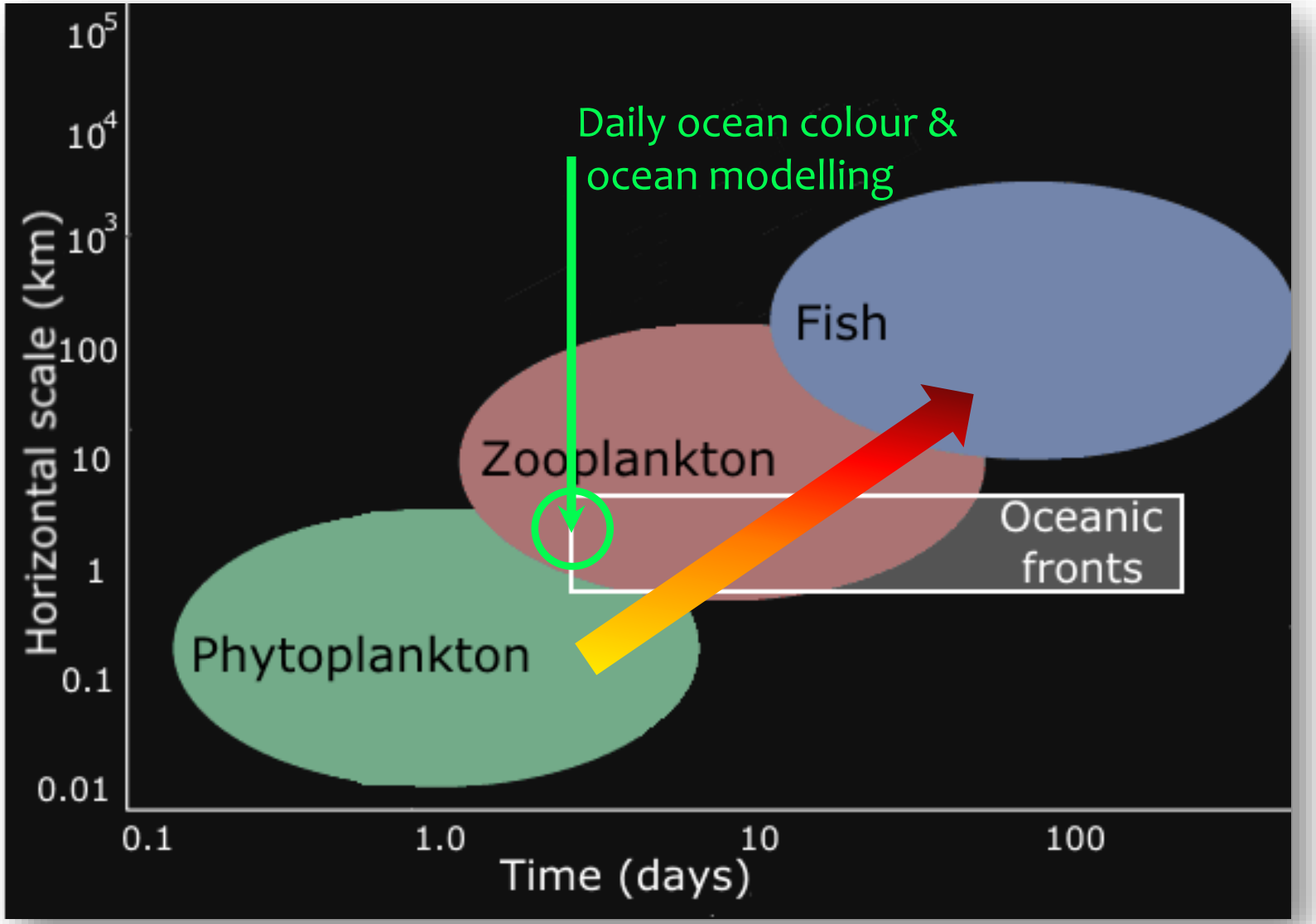
Productive fronts

- ✓ *Are areas of* ***continuous*** *primary production,*
- ✓ *Move few km/day ,*
- ✓ **For weeks to months,**
- ➢ *Are efficient vectors of energy from phytoplankton to zooplankton (the 10%).*



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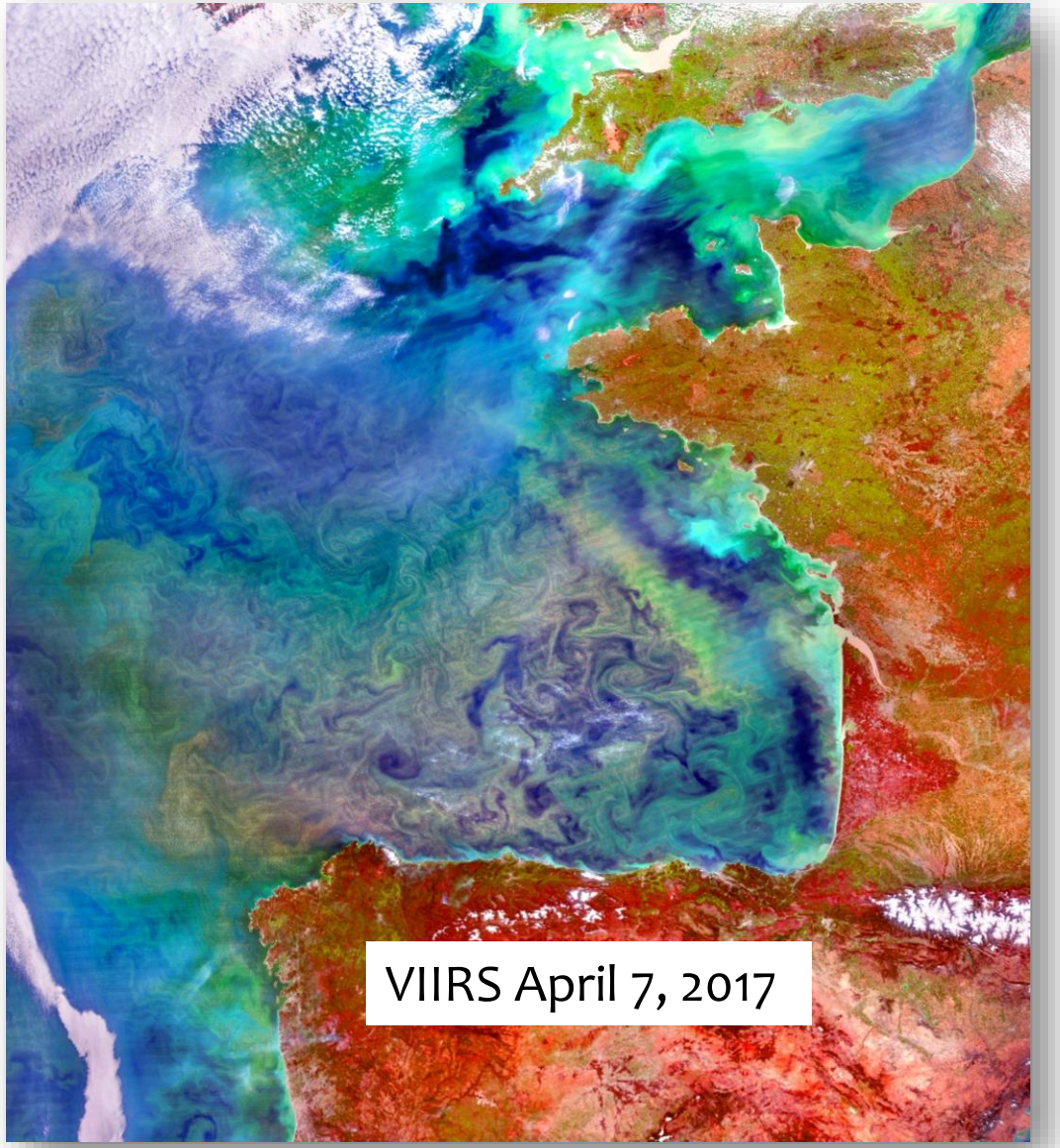
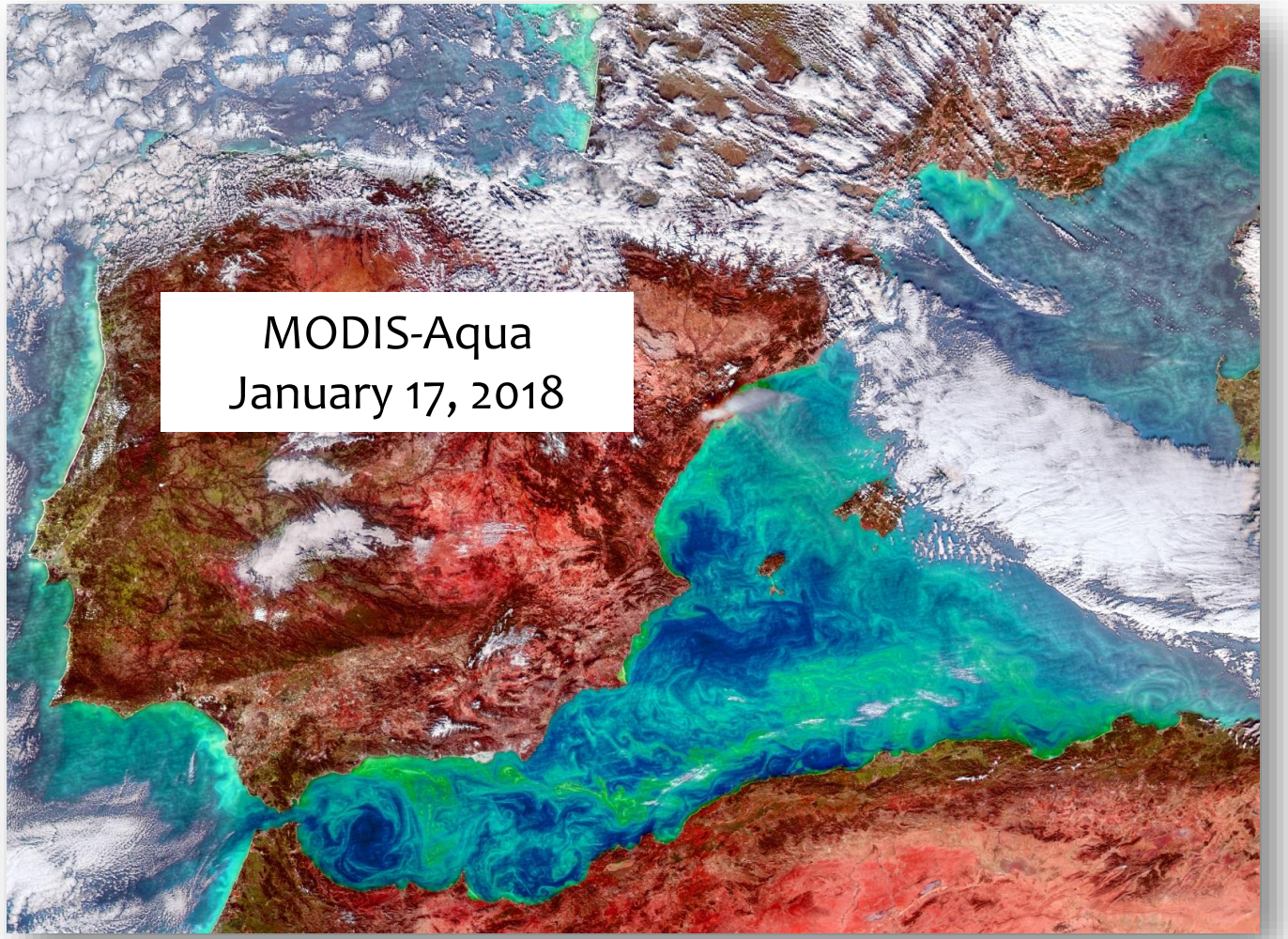
Productive fronts at mesoscale can be daily tracked by satellite sensors … and they are key to zooplankton production





From NASA Ocean Color gallery (enhanced pseudo-true colour images)
https://oceancolor.gsfc.nasa.gov/cgi/image_archive.cgi

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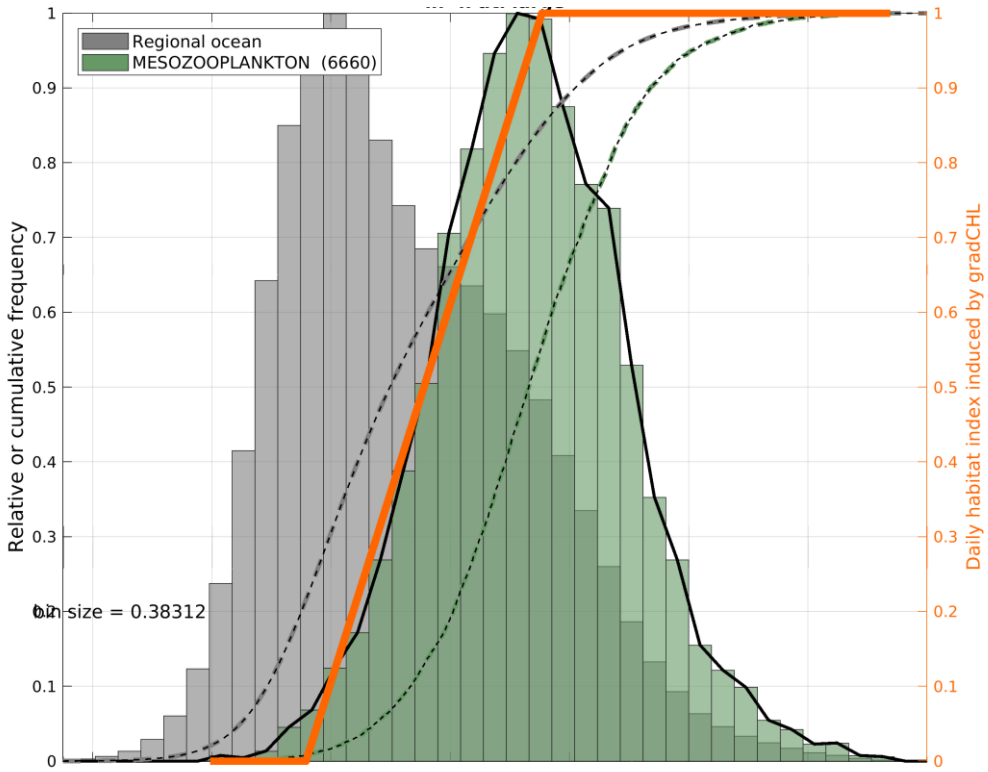
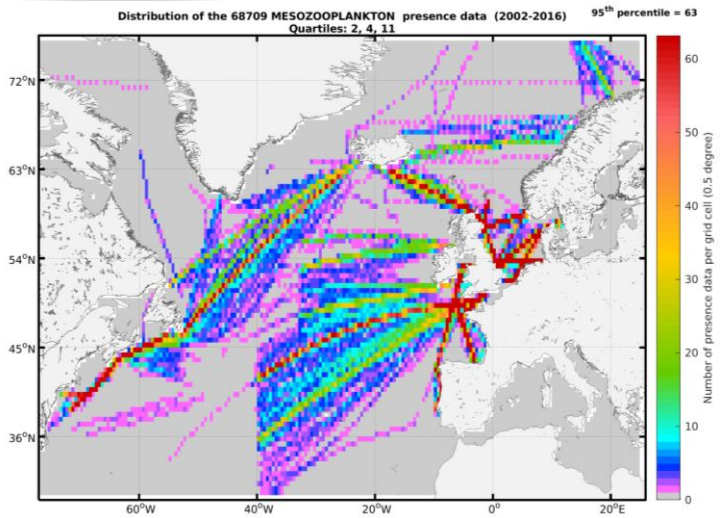
CHL front = proxy for food availability





No CHL fronts -→ Small fronts -→ Large CHL fronts

Daily habitat value = f(CHL front size)

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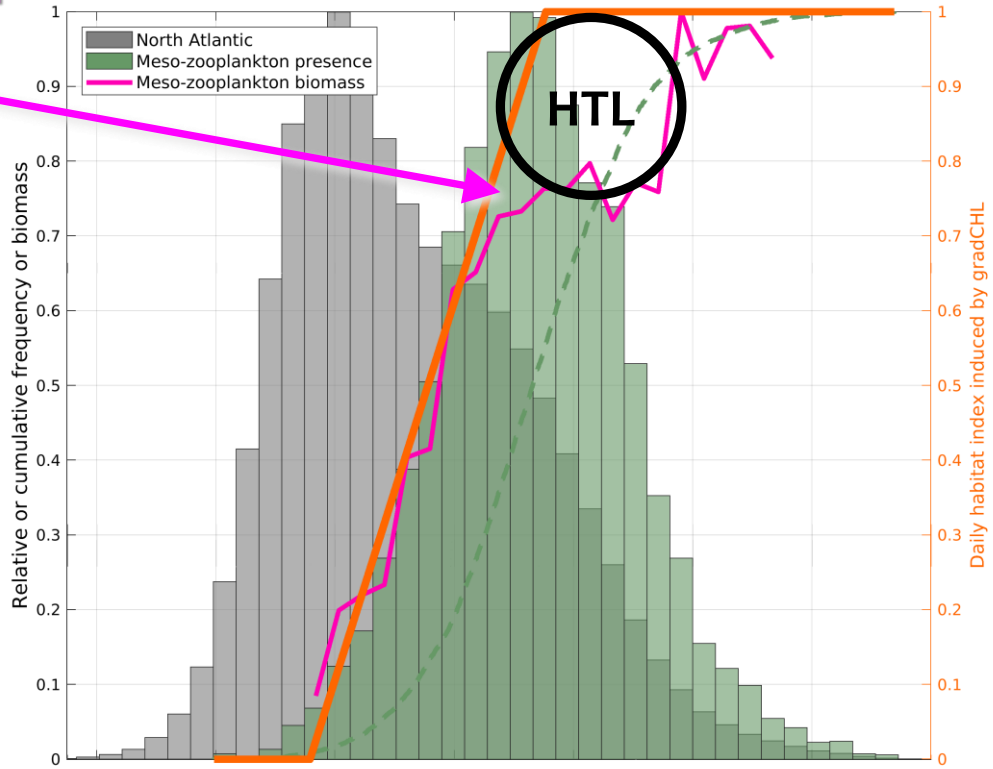
CHL front = proxy for food availability

Meso-zooplankton mean biomass



Log of **CHL gradient** (n = 6,660)

No CHL fronts -→ Small fronts -→ Large CHL fronts

Daily habitat value = f(CHL front size)

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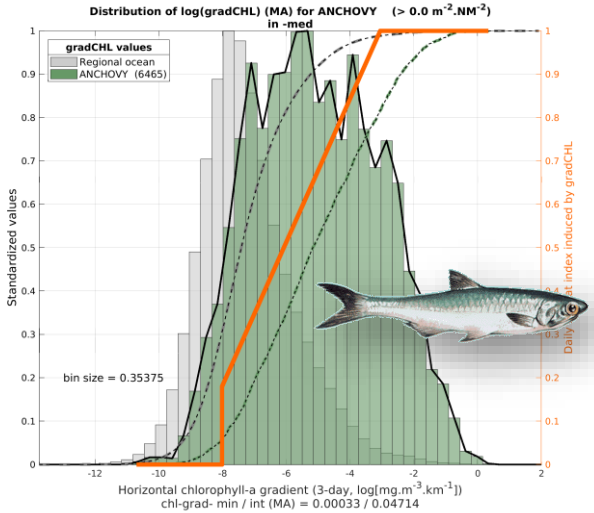
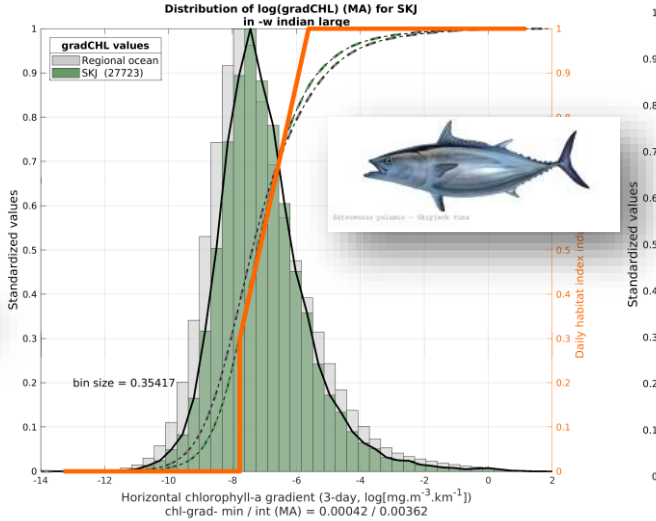
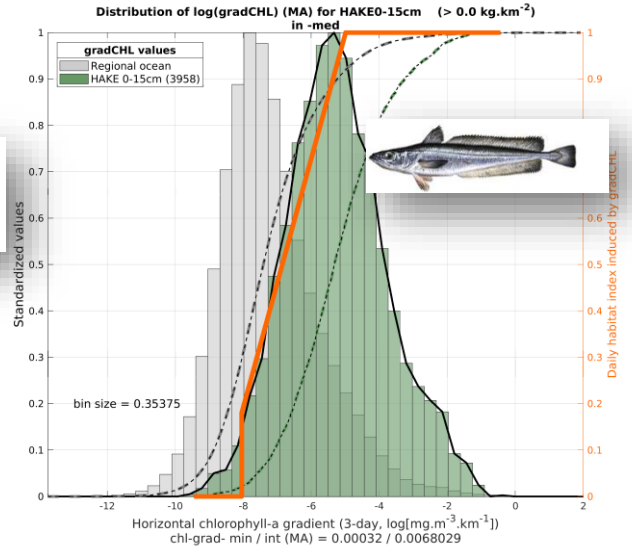
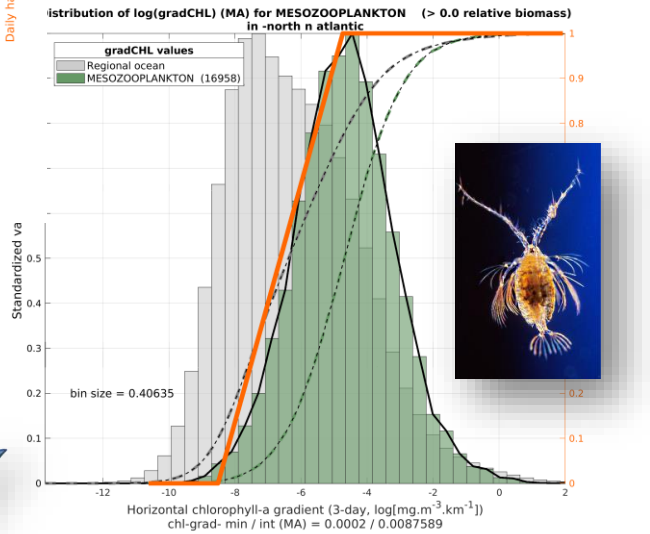
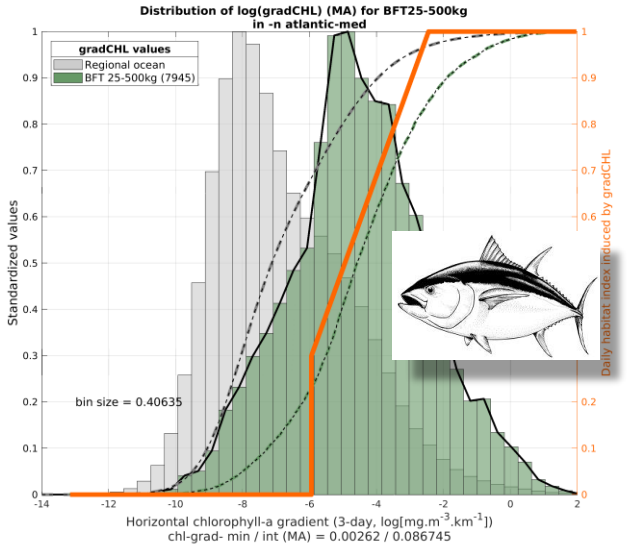


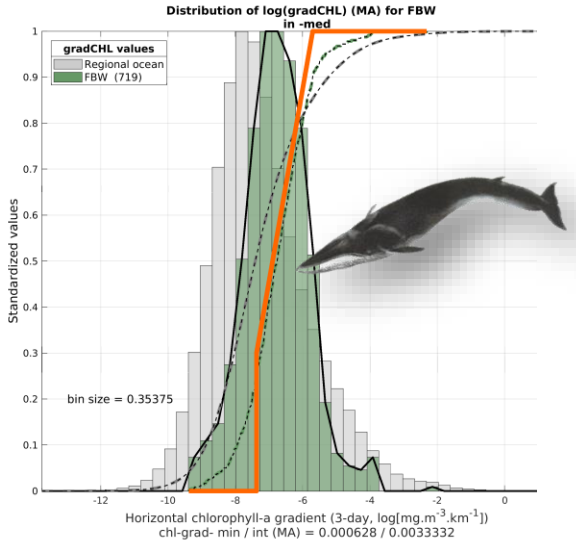


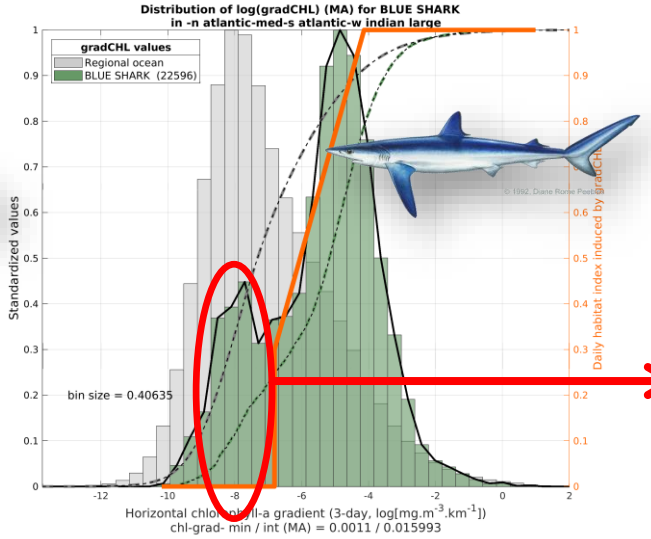


No CHL → Small CHL → Large CHL
fronts fronts fronts









No CHL → Small CHL → Large CHL
fronts fronts fronts

Peak presence of blue shark in oligotrophic environments

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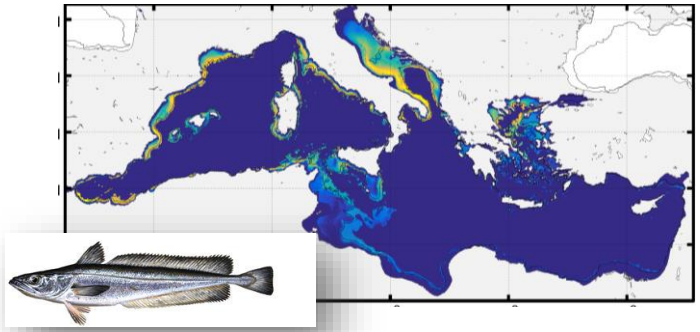
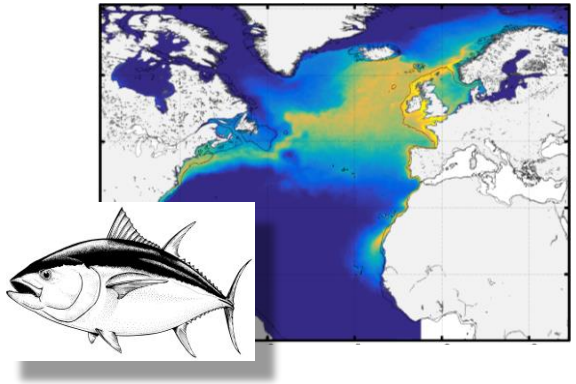
http://fishreg.jrc.ec.europa.eu/fish-habitat
https://data.jrc.ec.europa.eu/

PUBLISHED

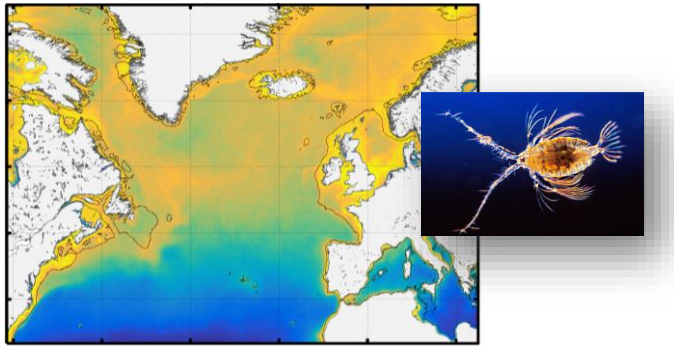
Hake nurseries (*Druon et al 2015*)



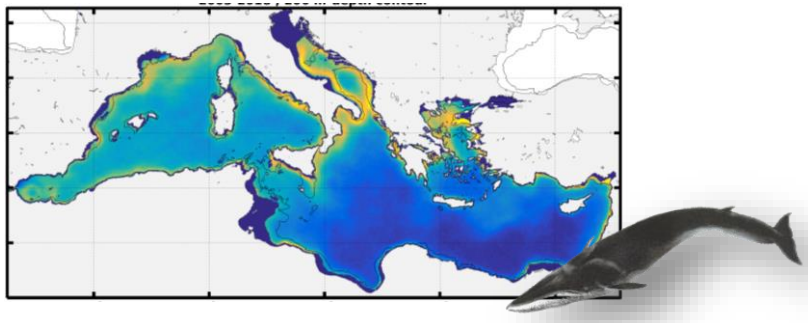
Atlantic bluefin tuna (*Druon et al 2016*)



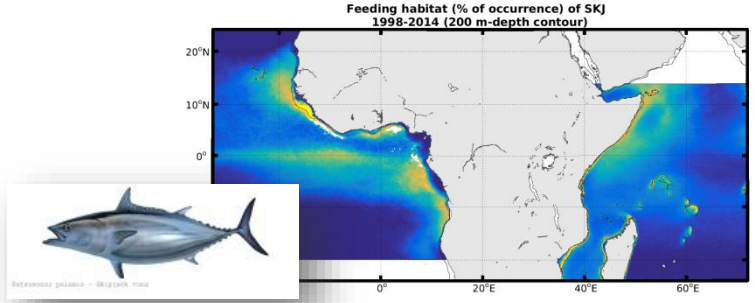
Mesozooplankton (*Druon et al. 2019*)



Fin whale (*Druon et al 2012*, *Panigada et al. 2017*)



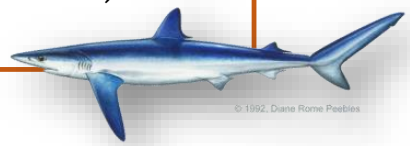
Skipjack tuna (*Druon et al 2017*)



ON-GOING STUDIES

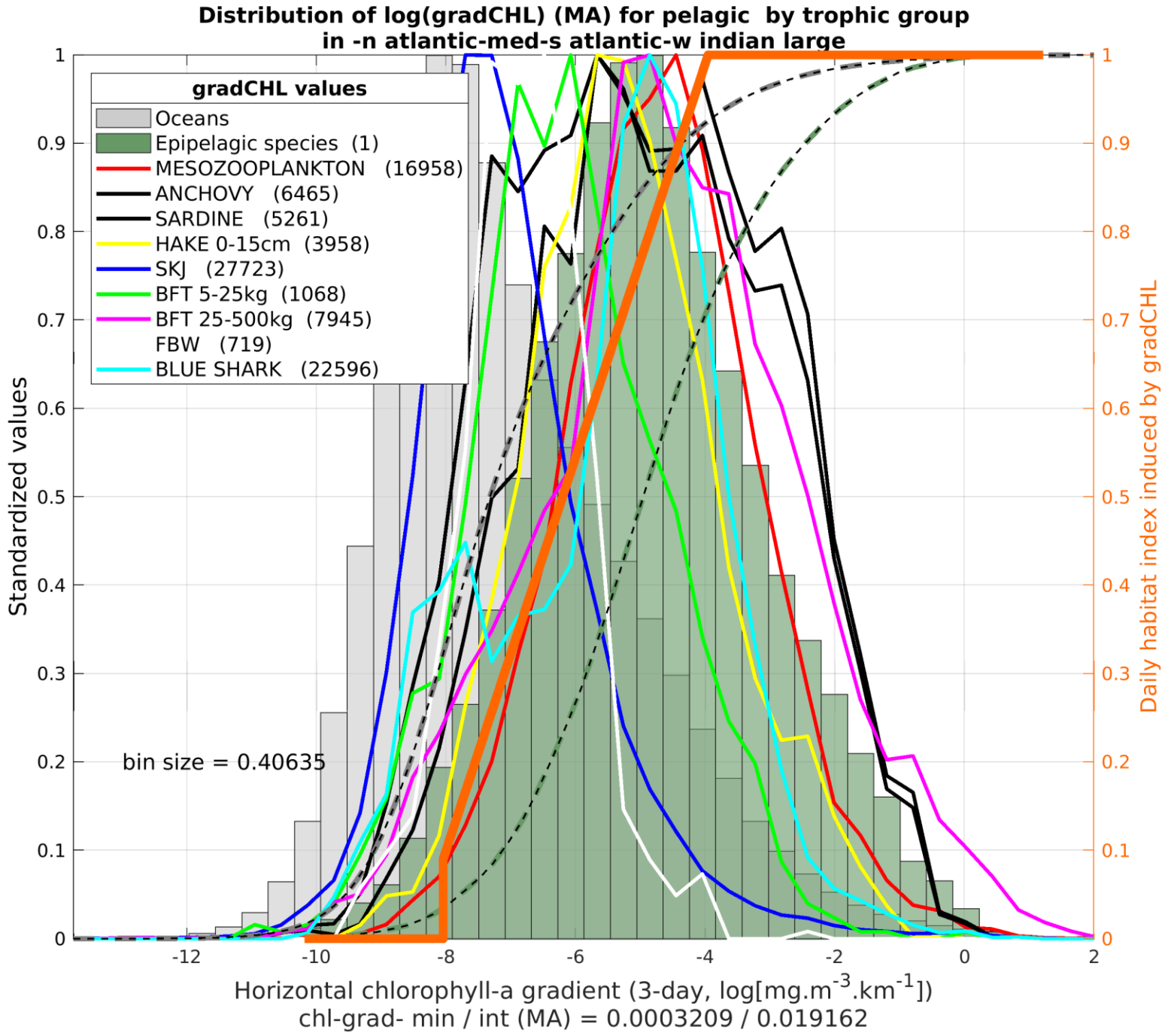
Blue shark *In prep.*

- *Atlantic, Indian, Med*
- *Global*



Ocean Productivity index to Fish (OPFish) *In prep.*

- *European Seas, global*



Ocean Productivity index for Fish:

formulation

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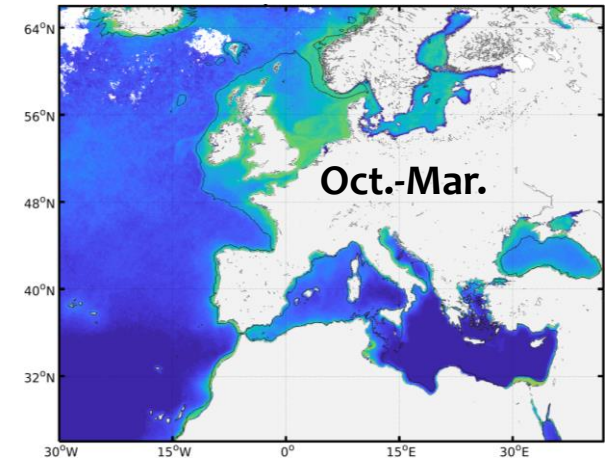
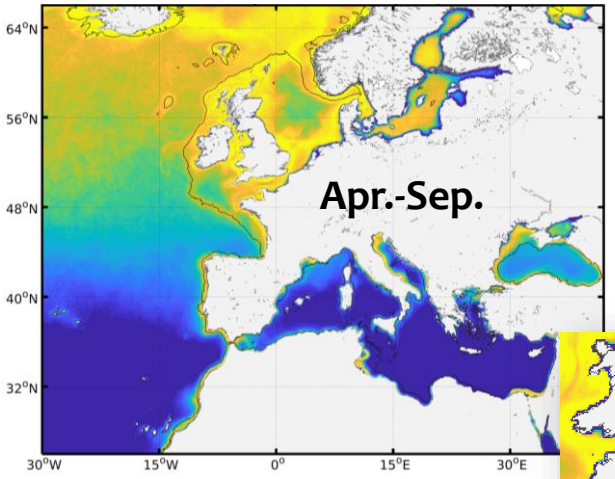
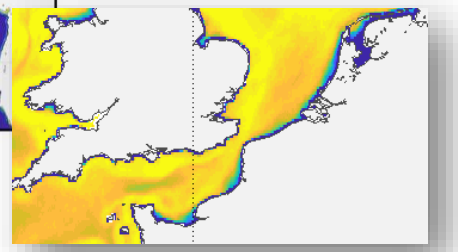
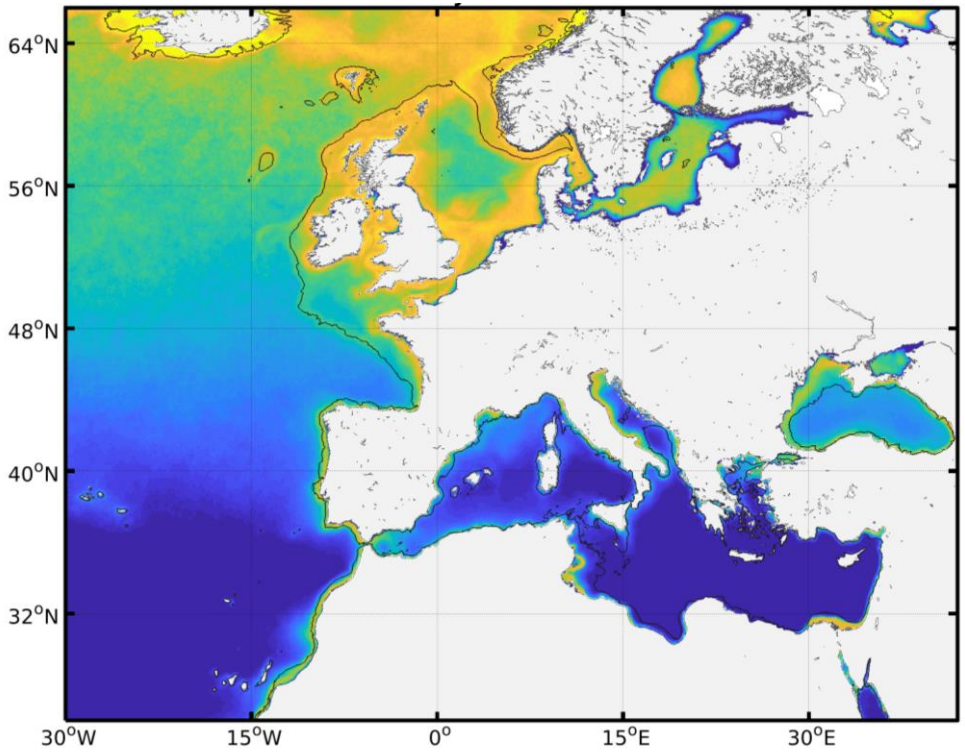
Ocean Productivity index for Fish (OPFish) 2003-2018 [MODIS-Aqua sensor]

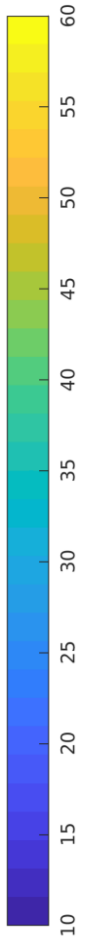
- **Represents CHL fronts intensity and frequency**
- Excludes CHL > 11 mg/m3 (potentially eutrophicated areas)
- **Includes day length**











HIGH OCCURRENCE OF LARGE PRODUCTIVE FRONTS

Energy-flow

LOW OCCURRENCE OF PRODUCTIVE FRONTS
OR
FREQUENT CHL > 11 mg/m3

OPFish is an algorithm converting CHL gradient (front) into a proxy for potential feeding

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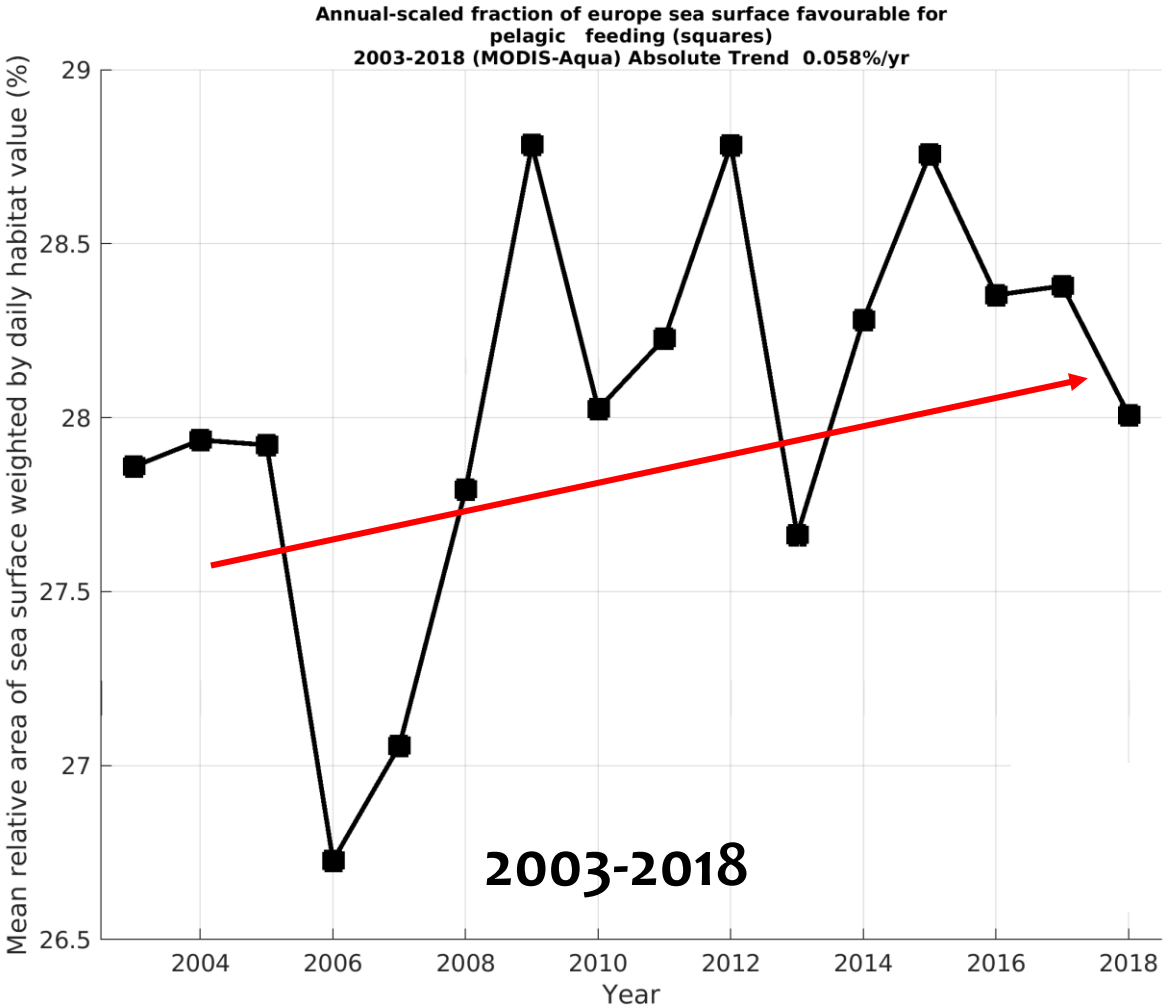
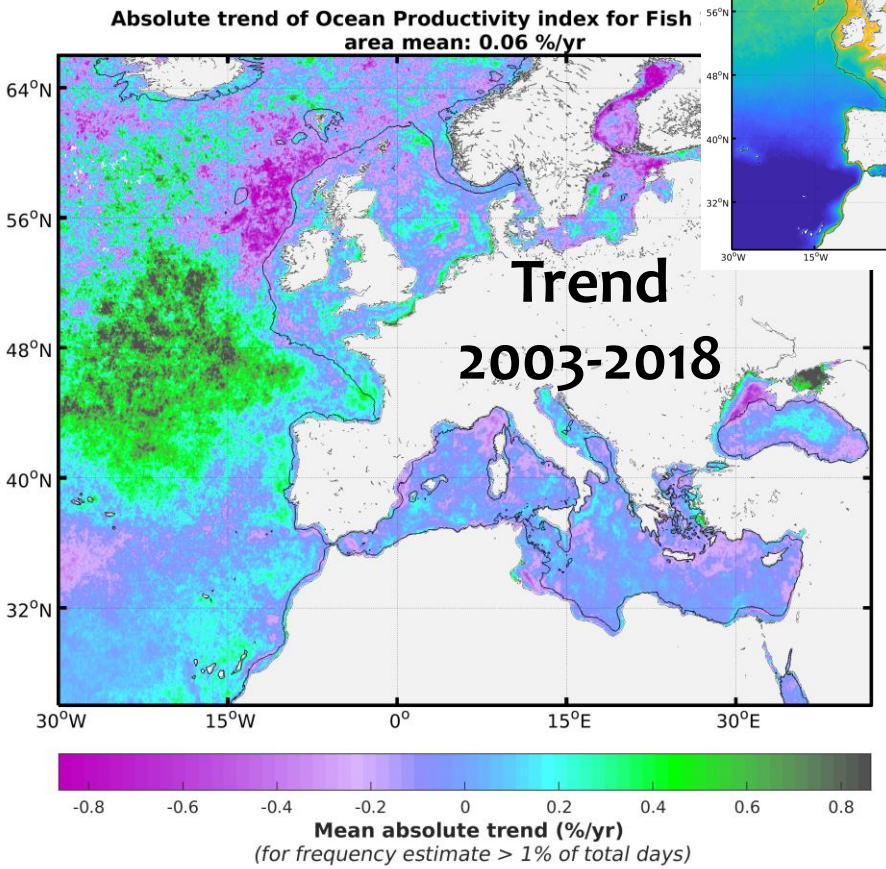
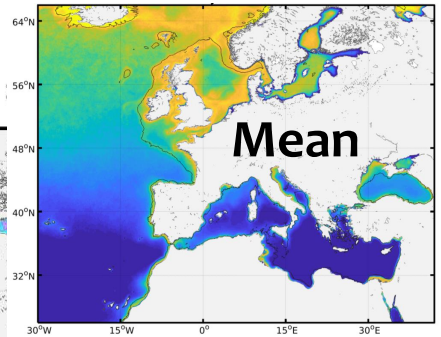
Trend of Ocean Productivity index for Fish







Relative trend (% / yr)

Maximum regional relative trends: ±25% /decade

Mean relative trends:

Europe +2.0% / *decade*

Global* +2.3% / *decade

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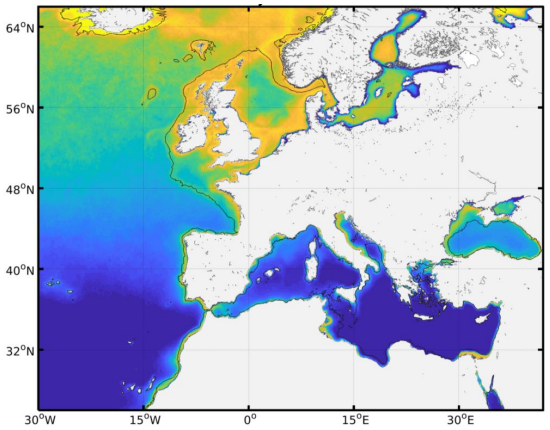
Concluding Remarks 1



The satellite monitoring of productive fronts allows identifying:

- the favourable feeding habitat of key marine species,
- the capacity of the marine environment to sustain food webs (indicator of zooplankton distribution = OPFish).

Habitat and productivity products:

- ➢ are mostly based on observations,
- ➢ are a monitoring tool at daily time scale,
- ➢ provide local variability after climate change (in the last 2 decades),
- ➢ are independent of fishing,
- ➢ are comparable globe-wise at 4 km resolution.

They are robust input data for **food web models** to reduce uncertainties:

- ➢ At zooplankton level,
- ➢ At HTL (species specific).

First description of the methodology in the Arctic Ocean:
http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109947/ocean_productivity_index_for_fish_in_the_artic.pdf

More information: jean-noel.druon@ec.europa.eu
http://fishreg.jrc.ec.europa.eu/fish-habitat

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Fisheries Data vs OPFish (day, 0.0417 deg.)

Data Collection Framework - DCF
(MS declaration, 2010-2016 quarters, ICES rectangles 1x0.5 deg.):

- **OSPAR 10-15 m, HELCOM 8-10-12-18-24-40 m: Fishing effort** (Hr -> kWHr using vessel length), **Landings all species** (tons), **LPUE**.
- **OSPAR+HELCOM area but no data from Iceland, Norway.**
- (Mediterranean Sea 0.5x0.5 deg. end 2019)
- **Gear groups:**
  - ✓ Pelagic gears – pelagic trawl + seine,
  - ✓ **Demersal mobile gears – bottom otter + demersal seine + beam,**
  - ✓ All gears above.
  - ✓ Dredges (mollusk weight) and passive gears (effort bias) were NOT considered.

ICES WGSFD - Spatial Fisheries Data (VMS+logbooks, 2009-2016 annual, 0.05x0.05 deg.):

- **Vessels > 12 m: Fishing effort** (kWHr), **Landings all species** (tons), **LPUE, Swept Area Ratio (SAR),** (Value).
- **OSPAR area but no data from Spain, Faroe Islands, Norway.**
- **Gear groups:**
  - ✓ **Demersal mobile gears – bottom otter + demersal seine + beam,**
  - ✓ Dredges (mollusk weight) and passive gears (effort bias) were NOT considered.

Scientific surveys DATRAS & MEDITS (2003-2016, trawl precision – day & mean haul position):

- **Fishing effort** (kWHr), **Catches all species by size** (kg), **CPUE (kg/km², wing & door spread)** .
- **DATRAS: OSPAR+West Baltic area but no data from Portugal, Norway & Western Channel.**
- **MEDITS: EU Mediterranean MS**
- **Bottom trawling**, excluding mollusks.
- ✓ **Codend mesh size of 20 mm (length DATRAS 8 m, MEDITS 9 m)**

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Fisheries Data vs OPFish (day, 0.0417 deg.)

Data Collection Framework - DCF (MS declaration, 2010-2016 quarters, ICES rectangles 1x0.5 deg.):

- **OPFish aggregated by 1x0.5 deg. and by quarter (or longer period).**

ICES WGSFD - Spatial Fisheries Data (VMS+logbooks, 2009-2016 annual, 0.05x0.05 deg.):

- **ICES WGSFD data interpolated to OPFish grid 0.0417x0.0417 (bilinear interpolation).**
- **OPFish integrated by year (or longer period).**

Scientific surveys DATRAS & MEDITS (2003-2016, haul precision – day & mean trawl position):

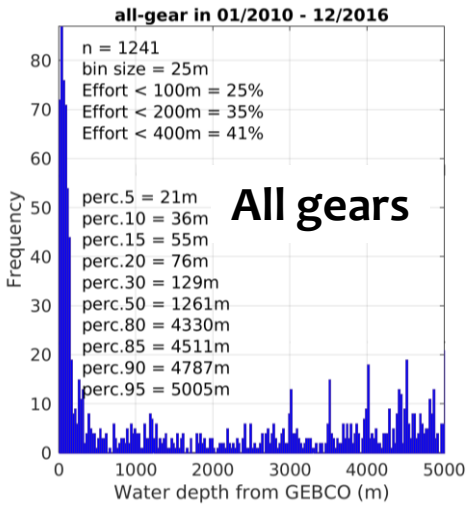
- **OPFish 1x1 or 3x3 pixels centered on each haul integrated by month (or longer period).**

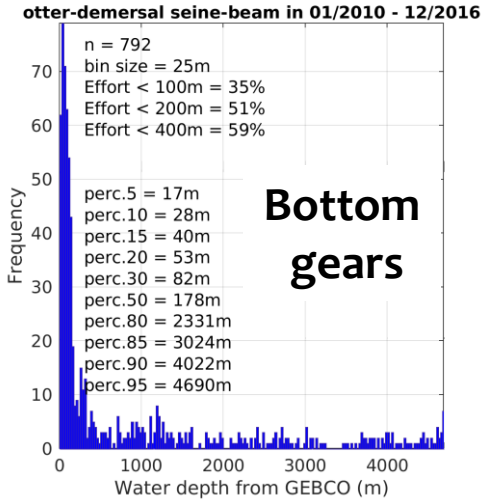
OPFish *vs* Data Collection Framework (DCF) (quarters 2010-2016, ICES rectangles)

Seek best correlation of OPFish with:

- **Fishing effort** (kWHr), **Landings** (tons), **LPUE**.

- **Gear groups:**
  - ✓ Pelagic gears – pelagic trawl + seine,
  - ✓ Demersal mobile gears – otter + demersal seine + beam,
  - ✓ All gears above.





- Data distributed in various **water depth**: all depths, <400 m, <200 m:

  BUT all results (maps) are shown for all depths for comparison
  (lower correlation coefficient for demersal/pelagic gears, r_s difference ~ 0.16)

- **OPFish integration time** before a given quarter (including it) from 3 to 48 months:
  - ✓ differences in r_s <0.01,
  - ✓ generally a correlation peak for ~14 months.

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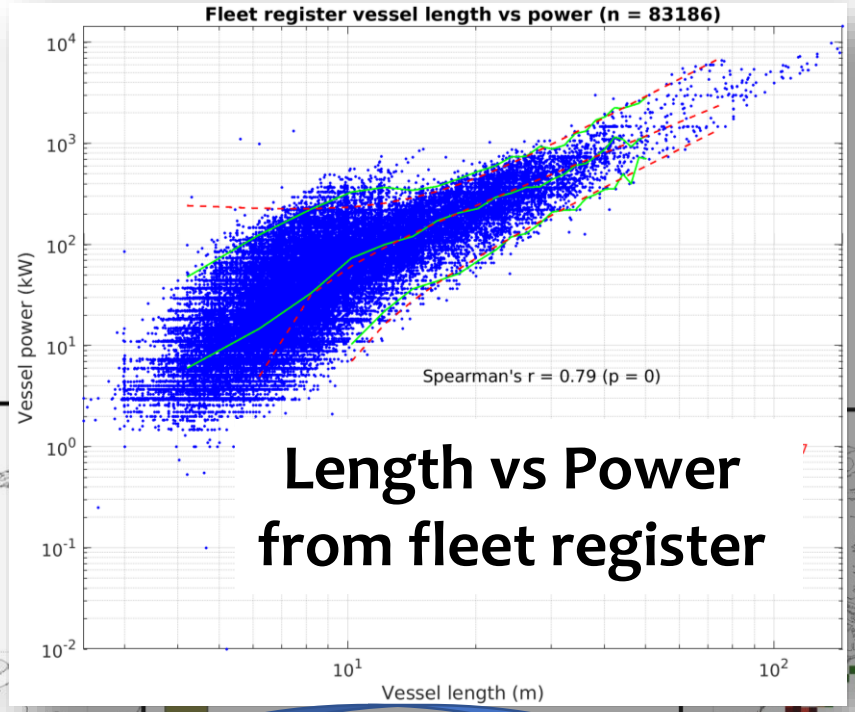
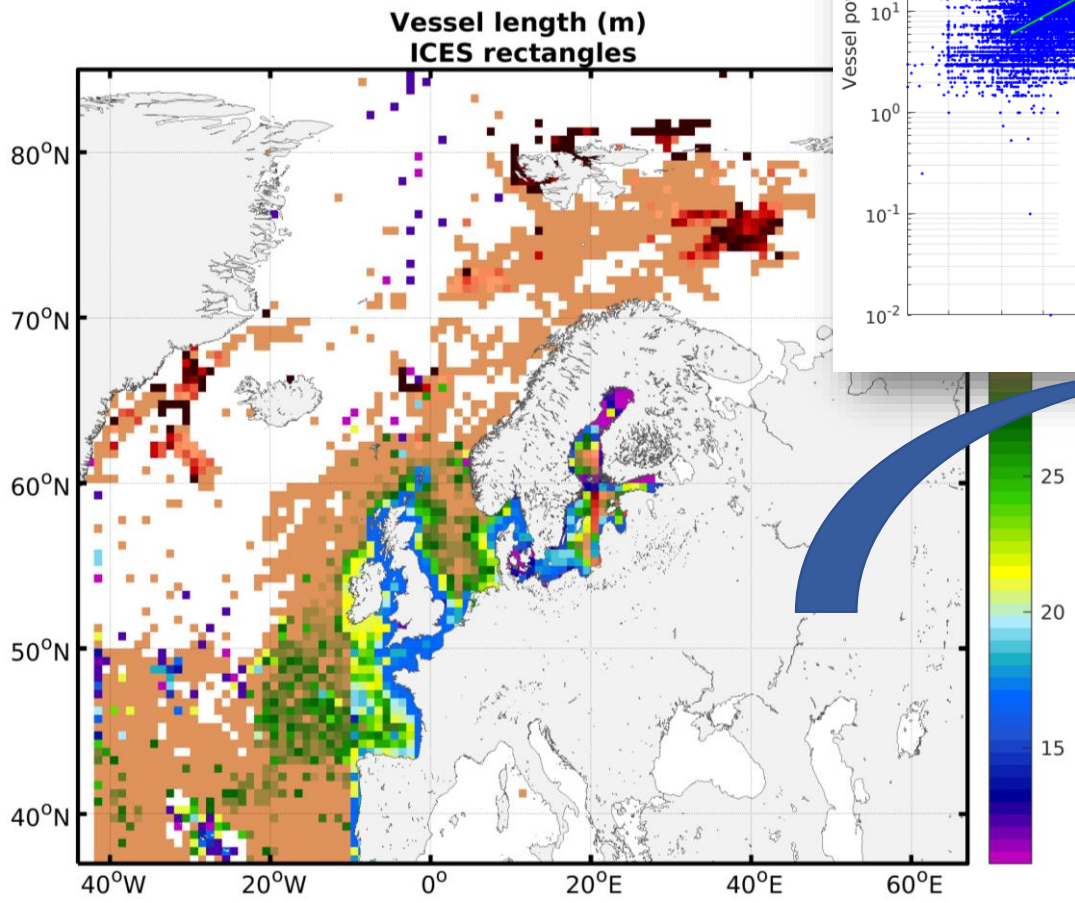
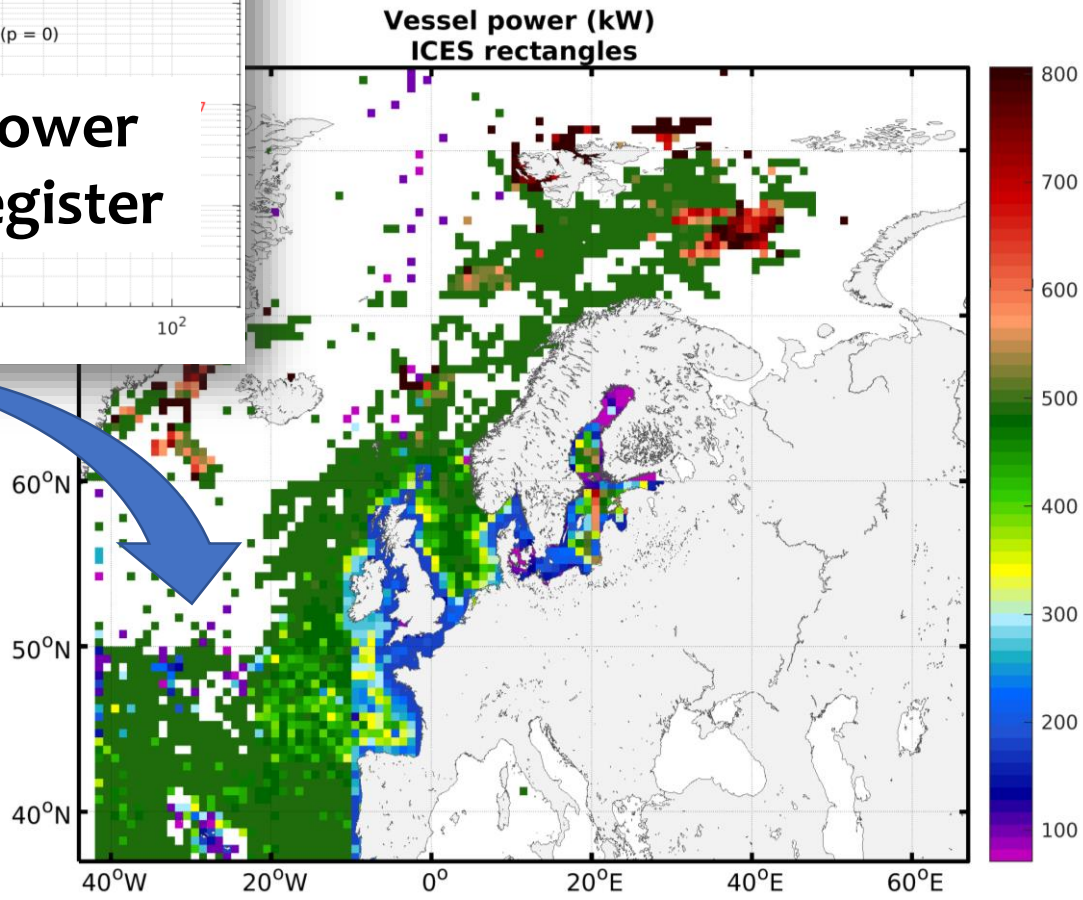
DCF effort from Hr to kWHr



Length vs Power from fleet register

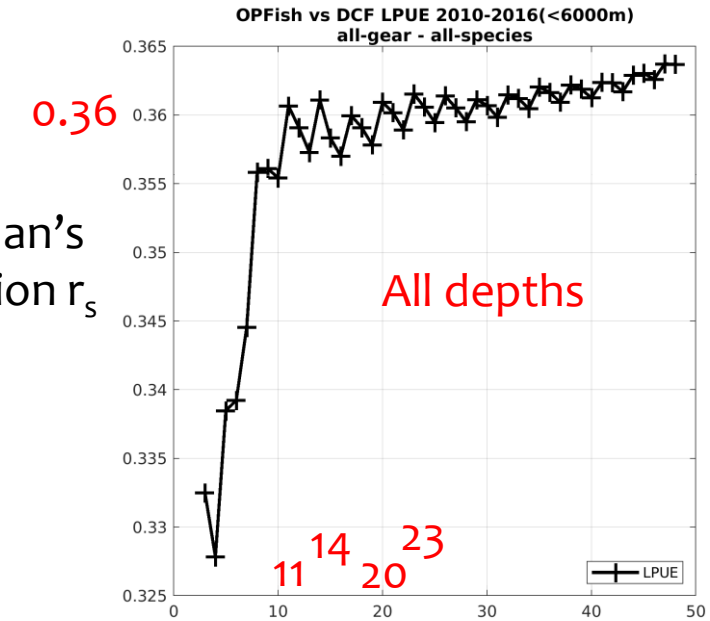


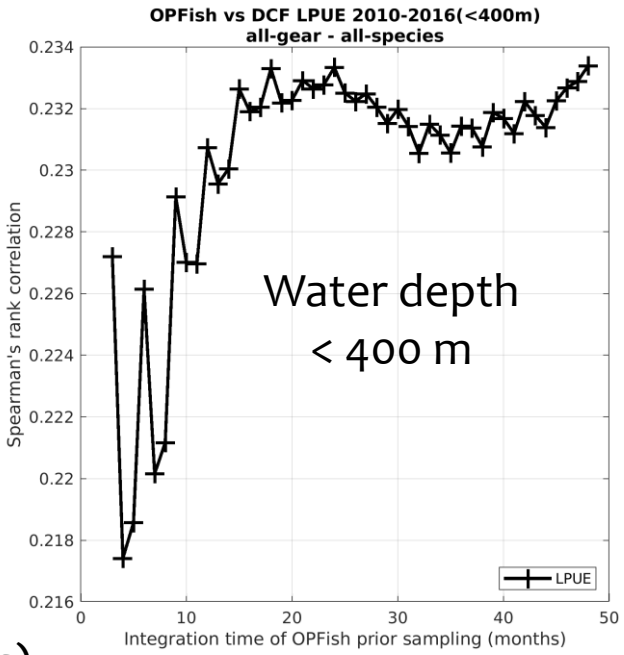


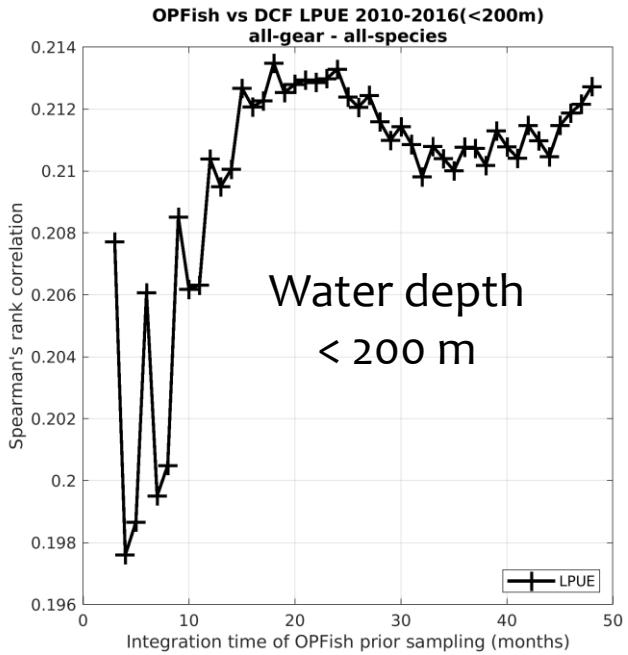
European Commission

DCF all gears LPUE correlation with OPFish increasing integration time

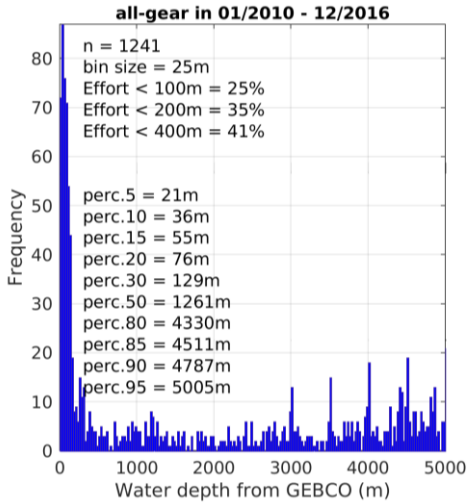
Spearman's correlation r_s







OPFish integration time (months)



DCF all gears

Highest correlation for:

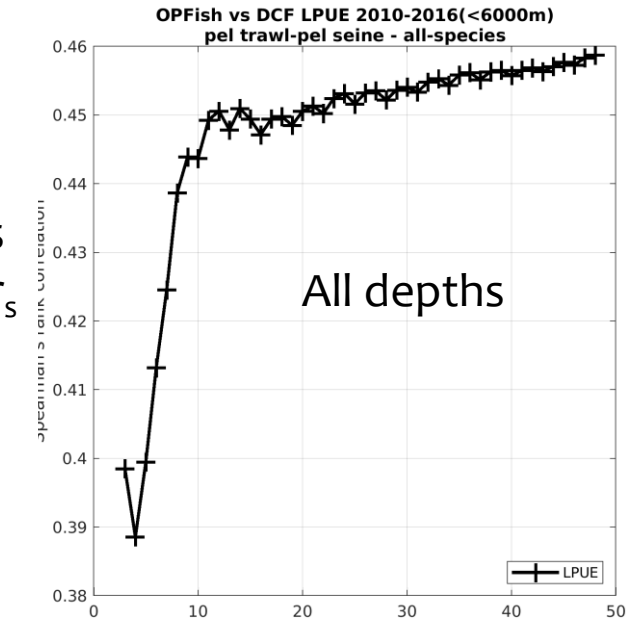
- All depths (0.36)
- OPFish integration time (first peaks)
  - ✓ All depths: 11 or **14** or 20 or 23 months
  - ✓ <400m/200m: 15, 18, 24

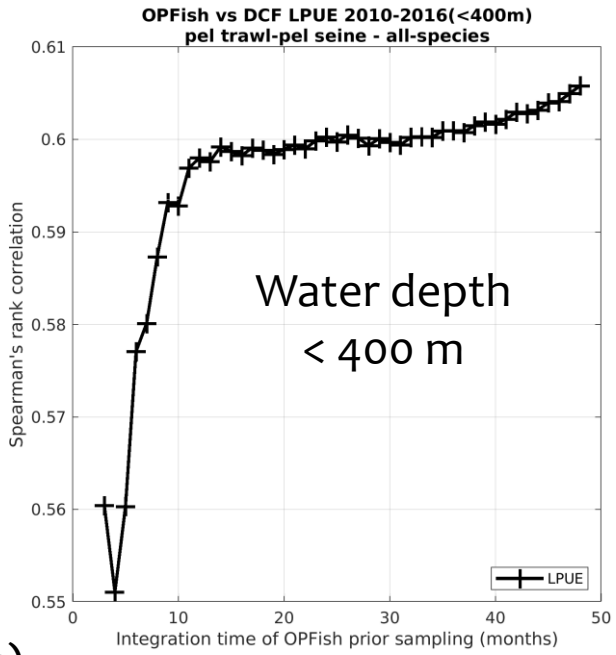
-> contrasted values of LPUE/OPFish when using all depth data

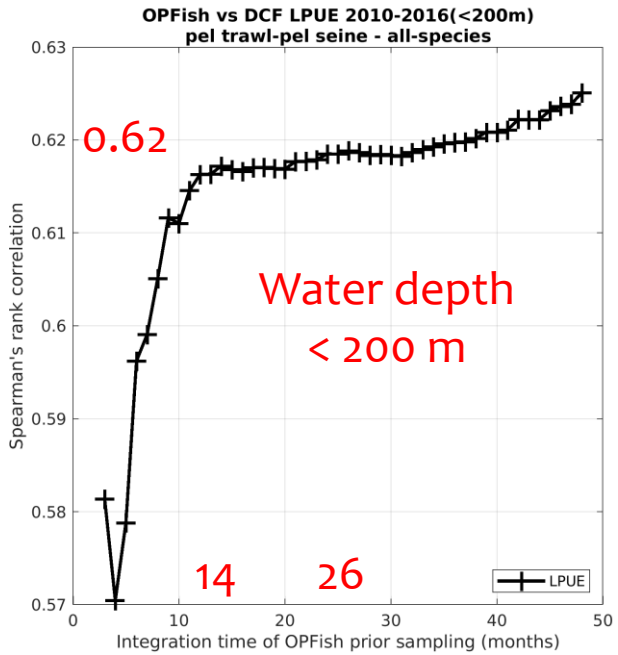
European Commission

DCF pelagic gears LPUE correlation with OPFish increasing integration time

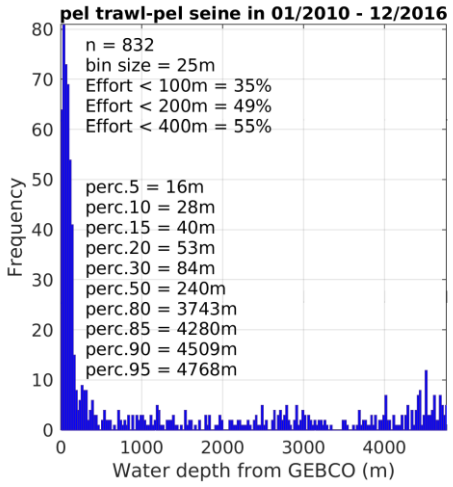
Spearman's correlation r_s







OPFish integration time (months)



DCF pelagic gears

Highest correlation for:

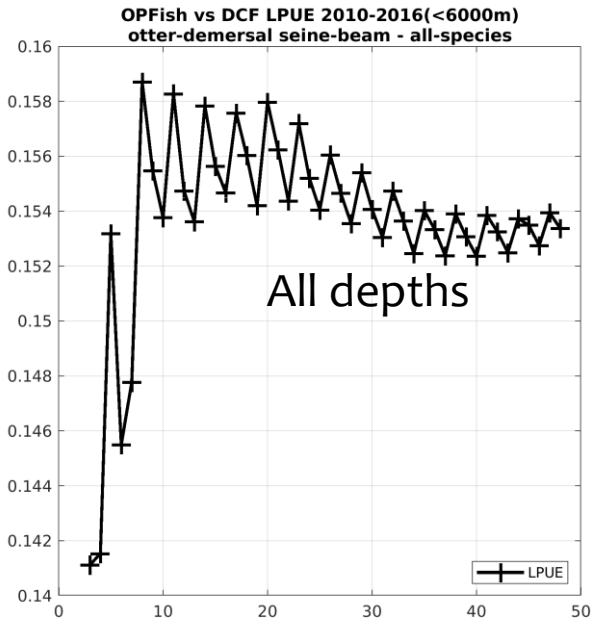
- Depth < 200 m (0.62)
- OPFish integration time (first peaks)
  - ✓ < 200m: **14** or 26 months
  - ✓ <400m: **14**, 24 months
  - ✓ All depths: 12, **14**, 24 months

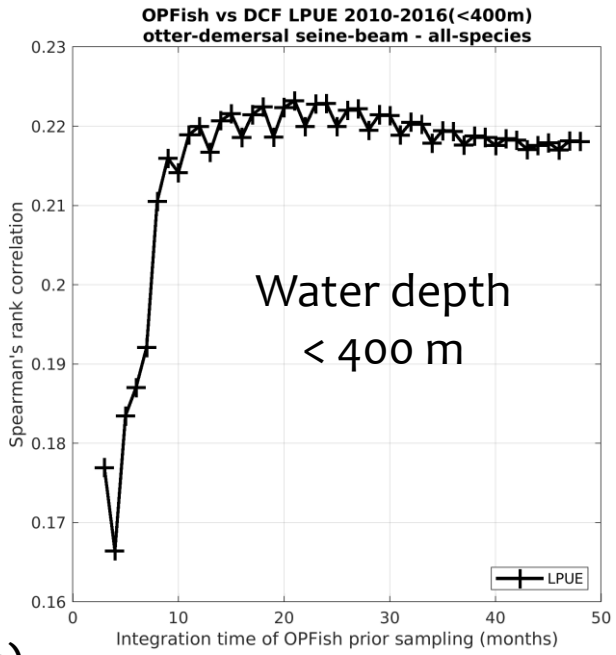
-> more stable productive features on the shelf

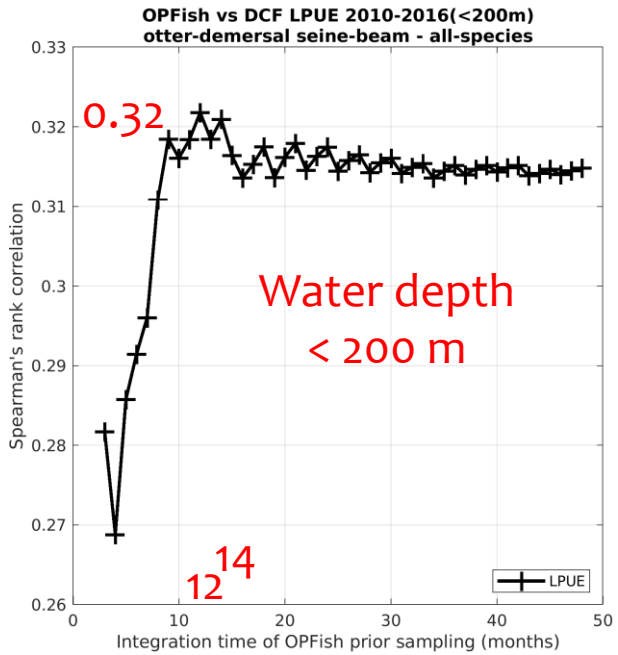
European Commission

DCF demersal gears LPUE correlation with OPFish increasing integration time

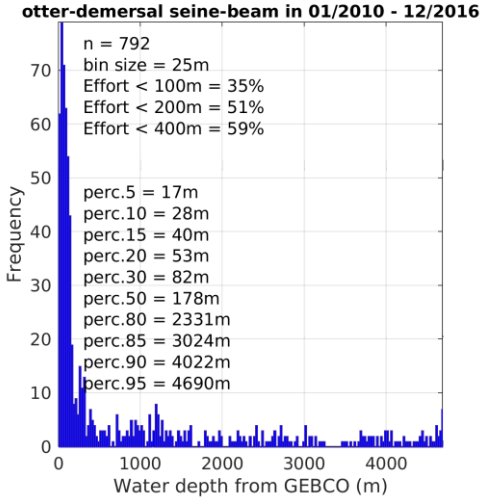
Spearman's correlation r_s







OPFish integration time (months)



DCF demersal gears

Highest correlation for:

- Depth < 200 m (0.32)
- OPFish integration time (first peaks)
  - ✓ <200 m: 12 or **14** months
  - ✓ <400m: 12, 15, 18, 21 months
  - ✓ All depths: 8, 11, **14** months

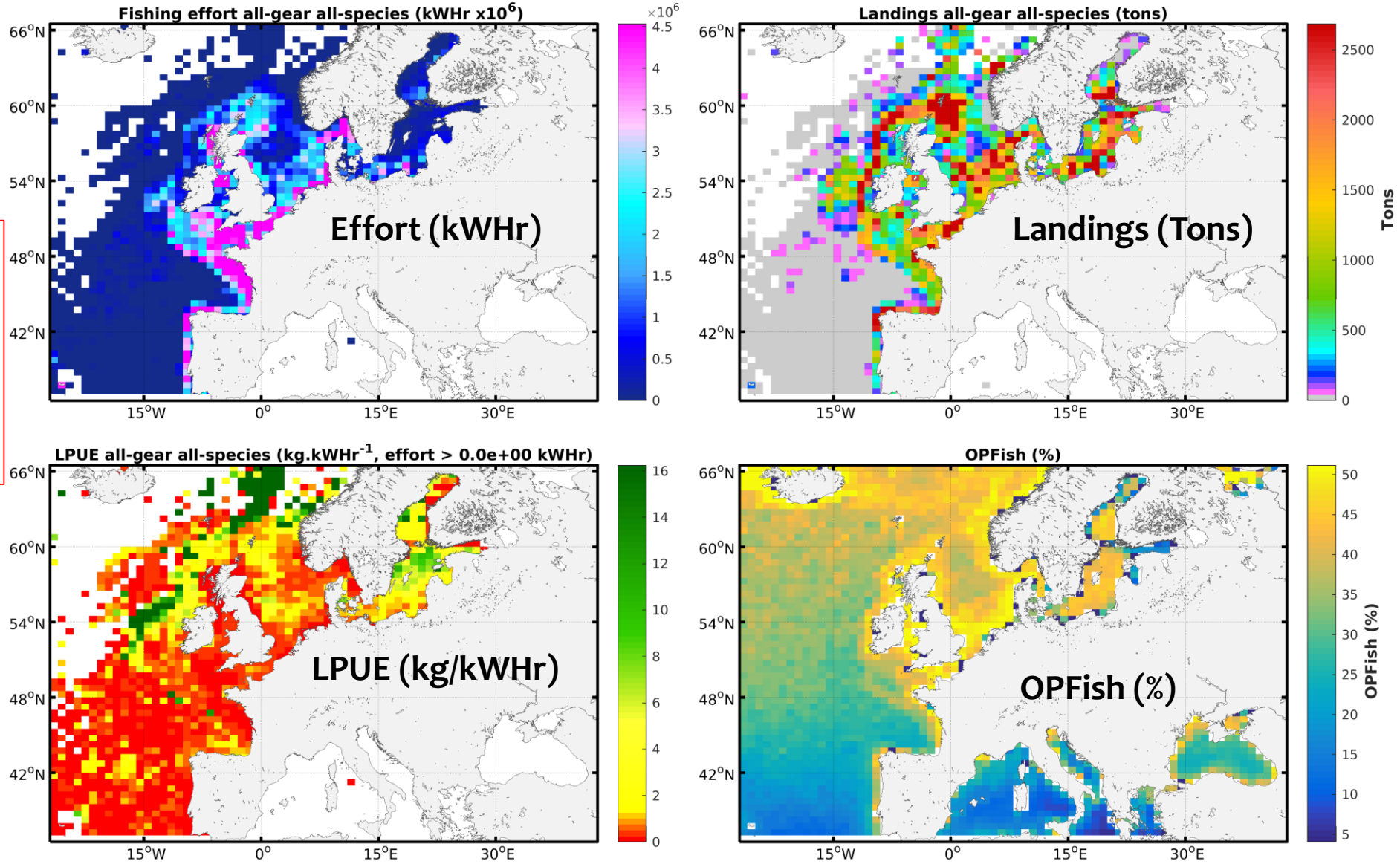
-> more stringent link with OPFish for shallow depth

European Commission

OPFish *vs* Data Collection Framework (quarters 2010-2016, ICES rectangles)

All gears

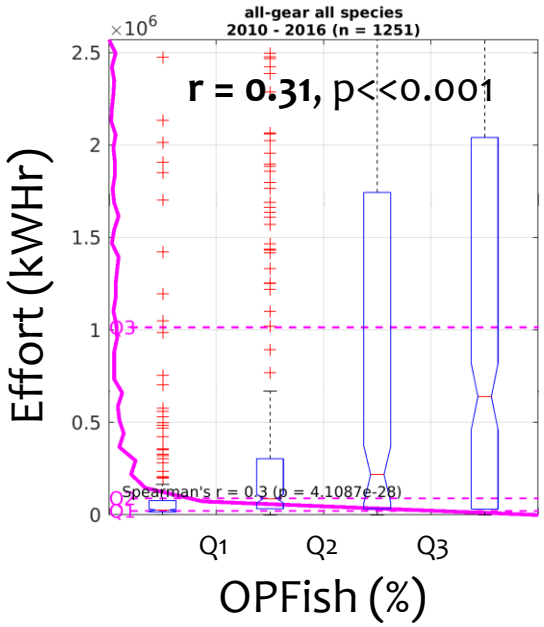
All species
By quarter

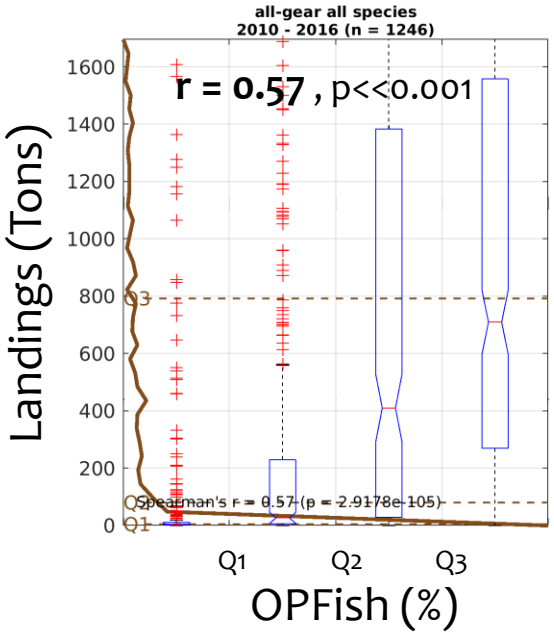


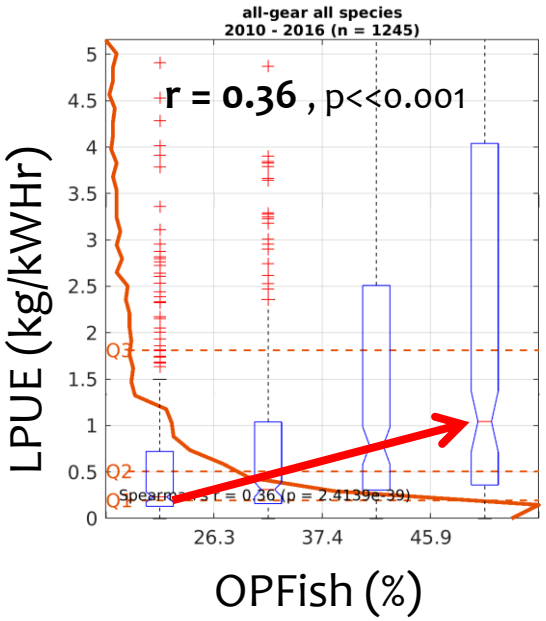
European Commission

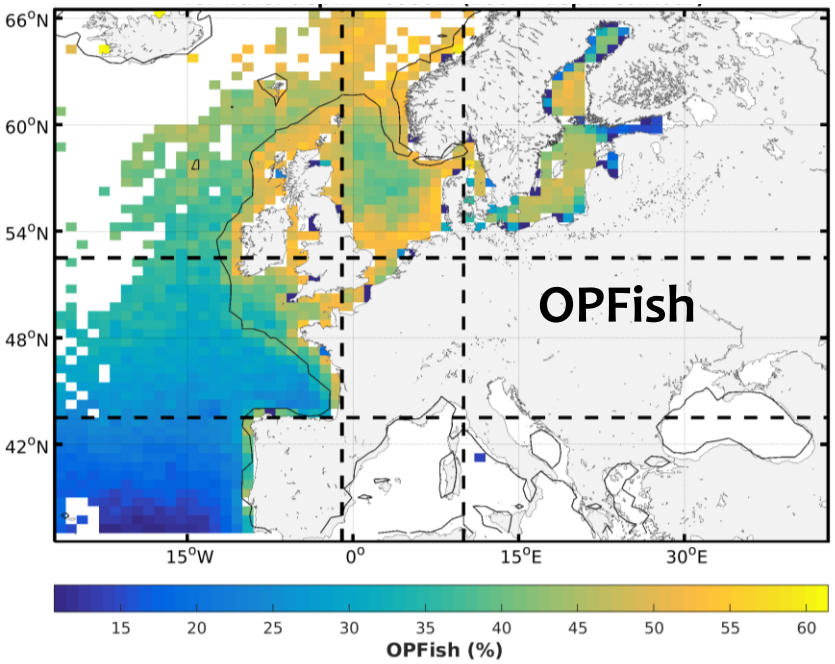
All gears

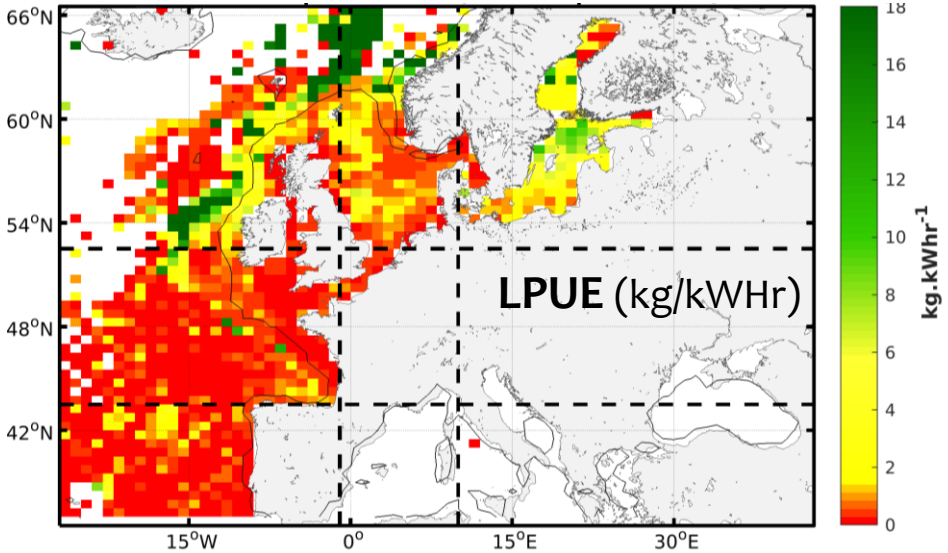
All species
By quarter









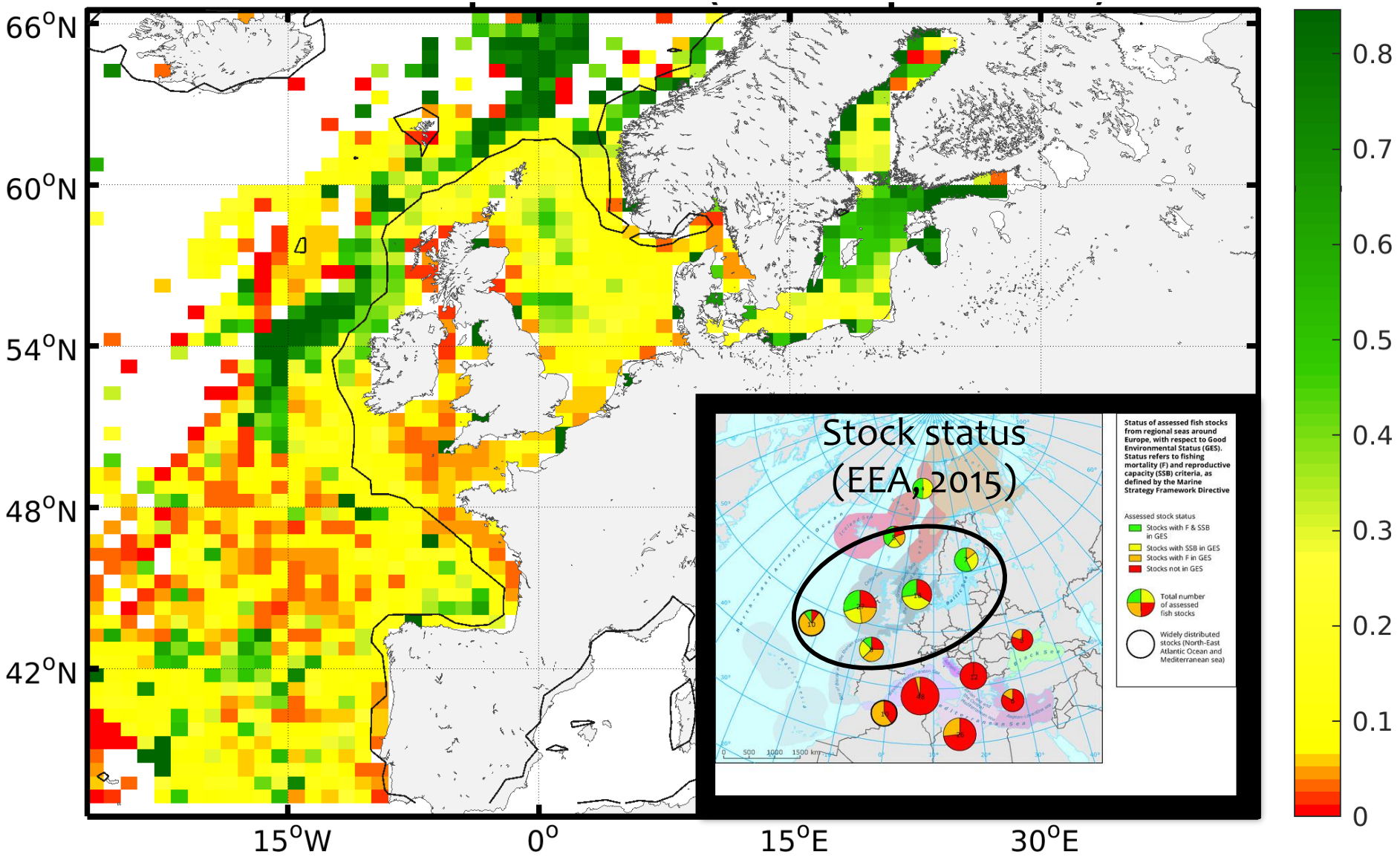


Low LPUE (red) means naturally poor area or potentially over-exploited

European Commission

Normalized LPUE/OPFish ratio
= Effective fishing yield / Potential fishing yield
= exploitation status?

Normalization = (x-xmin)/(xmax-xmin)
In logarithm form for LPUE
Max colorbar= perc.95th



Potentially healthy exploitation

Potentially over-exploited

All gears

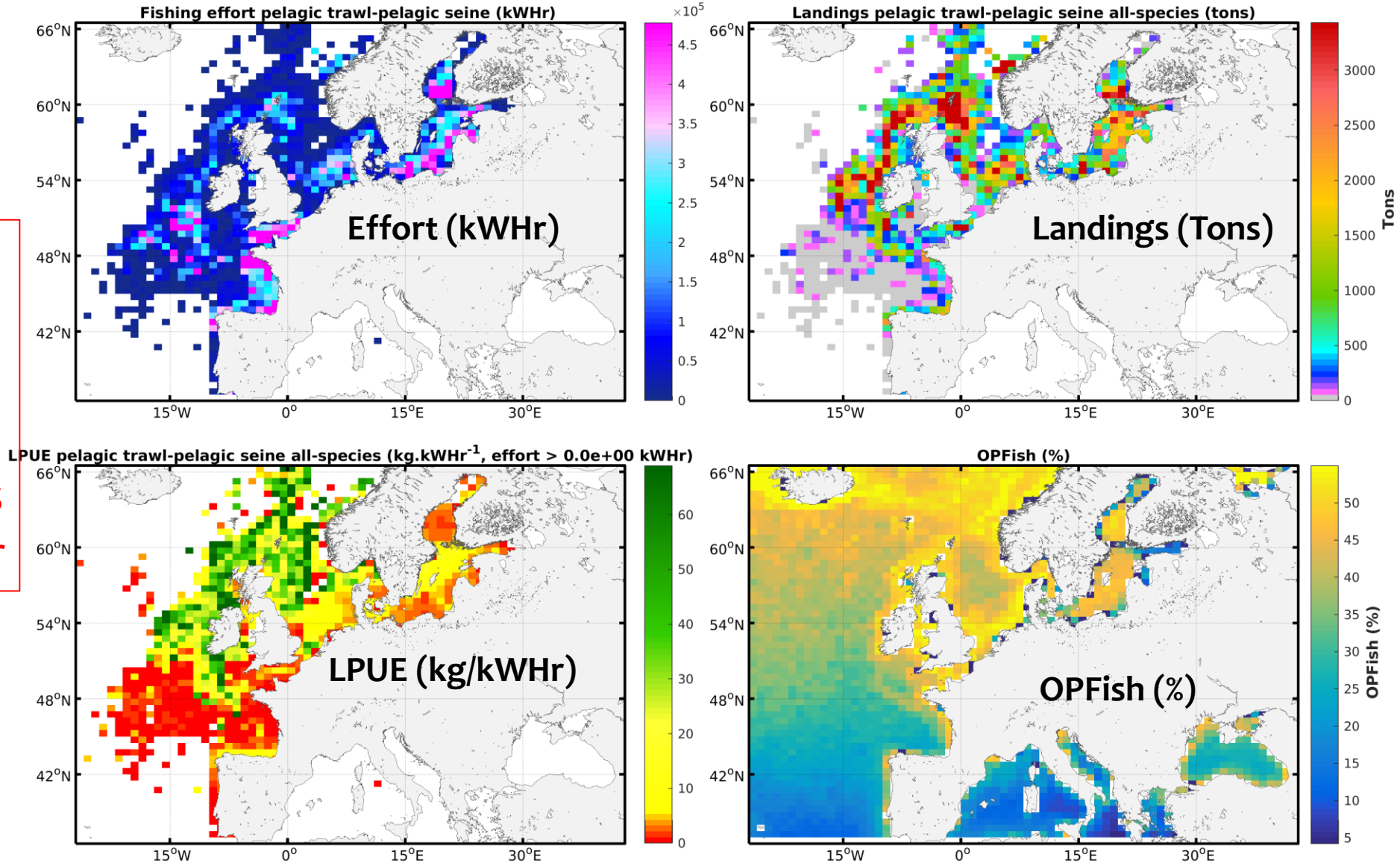
All species
By quarter

European Commission

OPFish *vs* Data Collection Framework (quarters 2010-2016, ICES rectangles)

Pelagic gears
(trawl & seine)

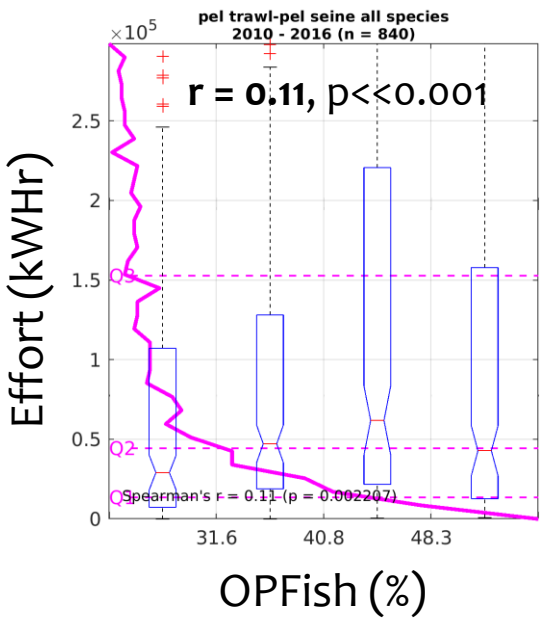
All species
By quarter

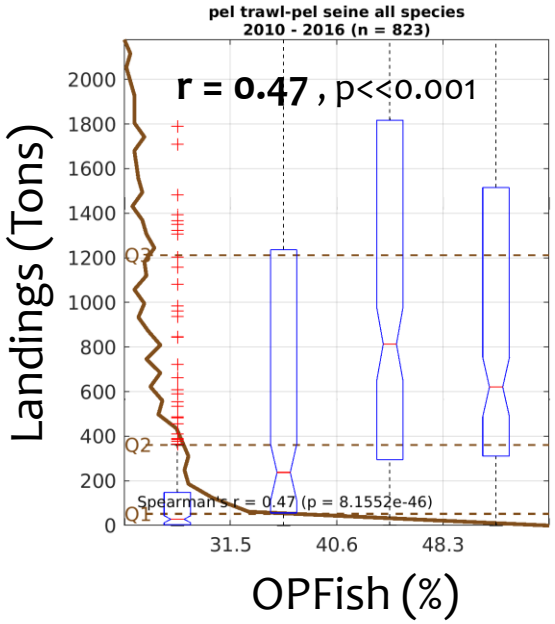


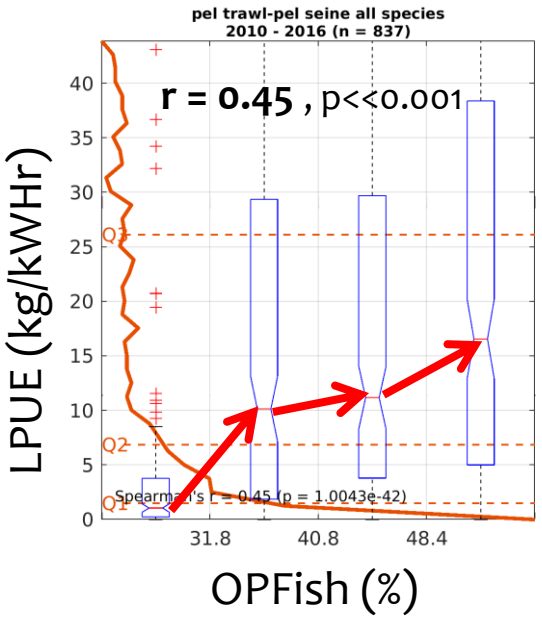
European Commission

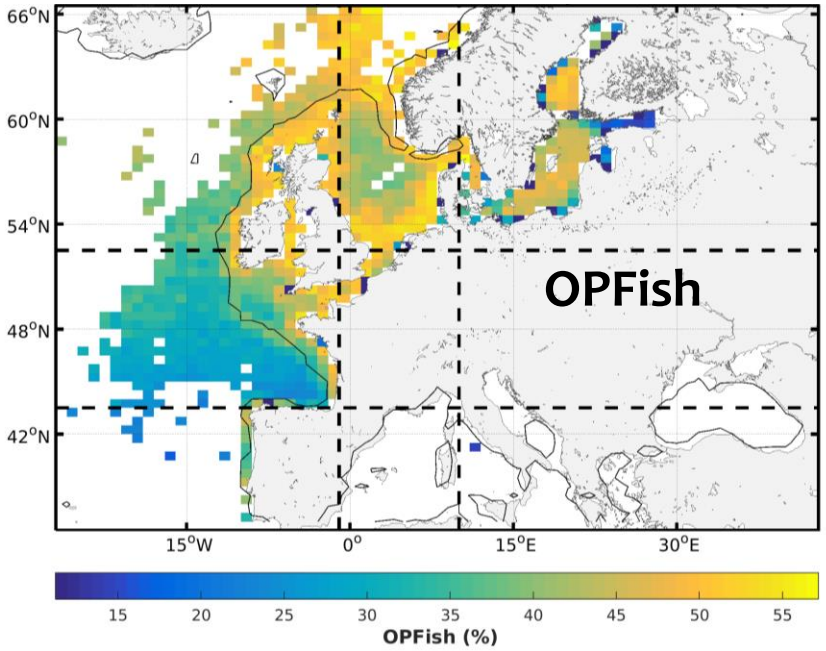
Pelagic gears
(trawl & seine)

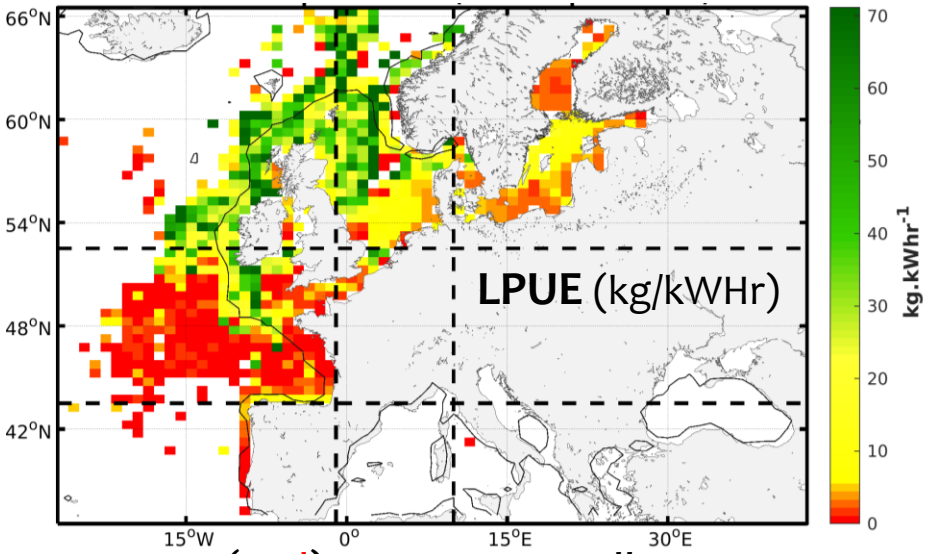
All species
By quarter











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European Commission

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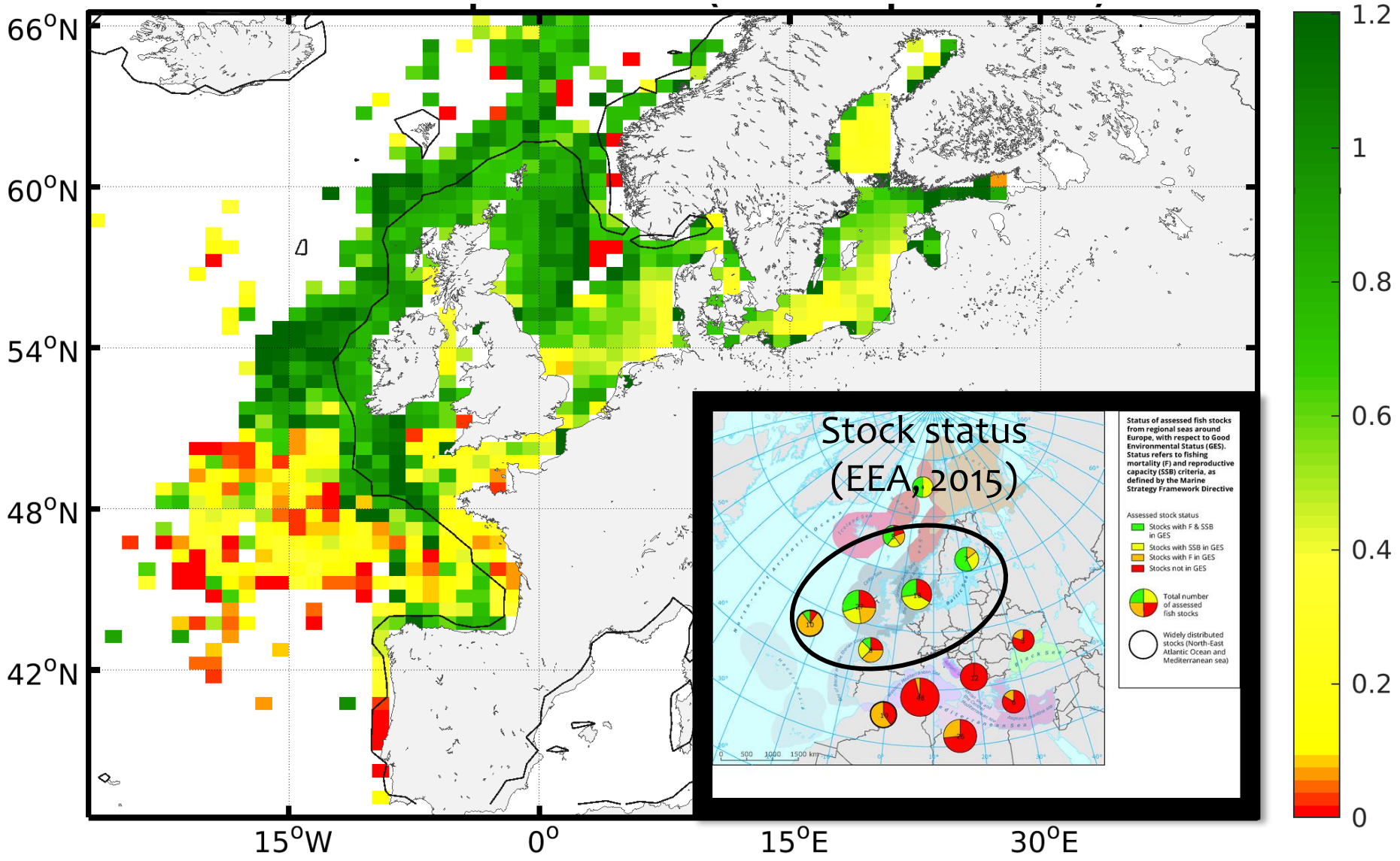


Potentially healthy exploitation

Potentially over-exploited

Pelagic gears
(trawl & seine)

All species
By quarter

European Commission

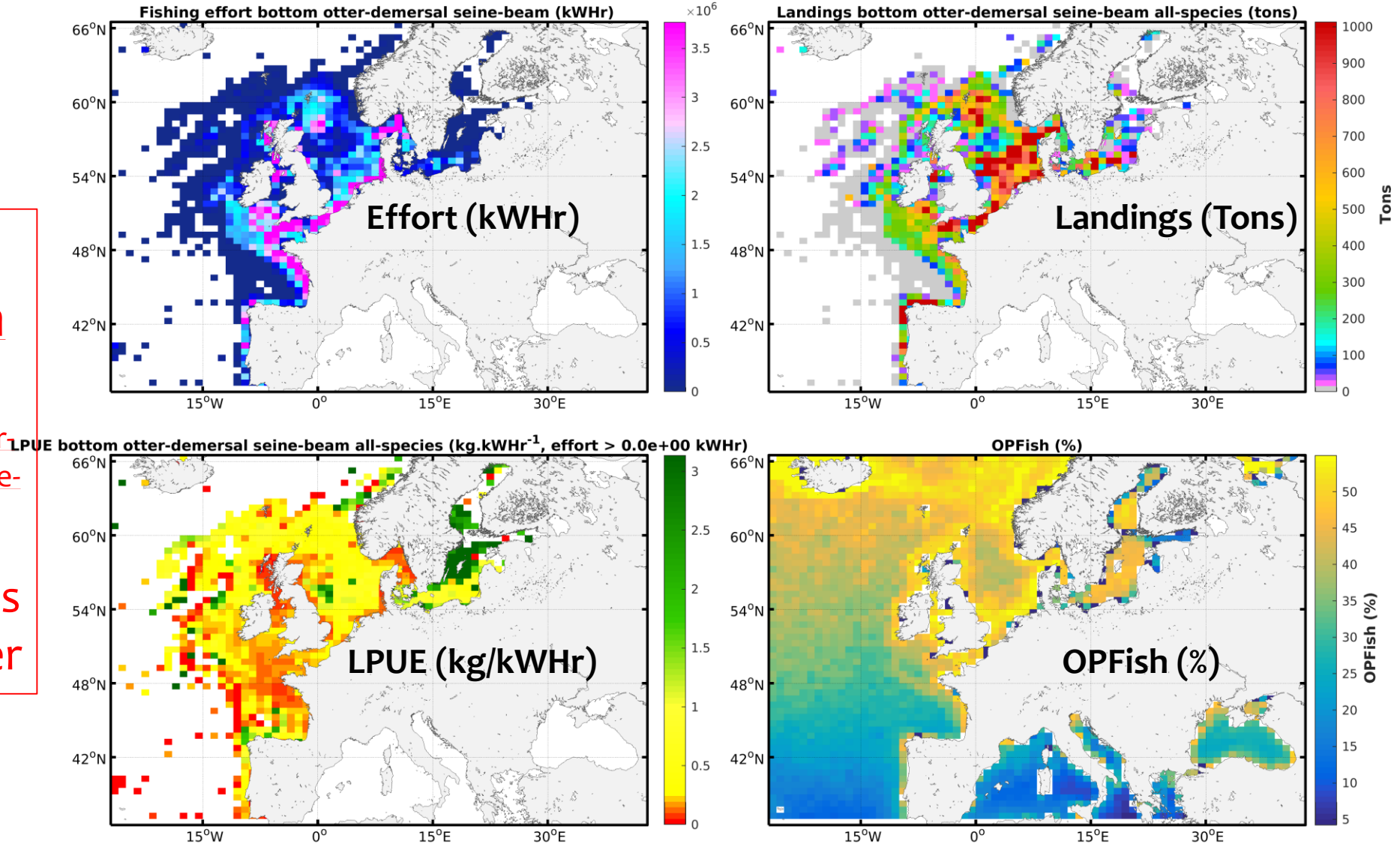
OPFish *vs* Data Collection Framework (quarters 2010-2016, ICES rectangles)

Mobile bottom gears

(bottom otter-demersal seine-beam)

All species

By quarter

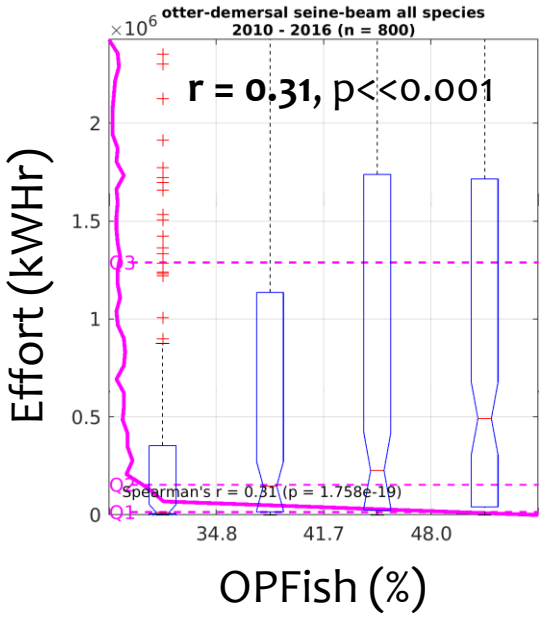


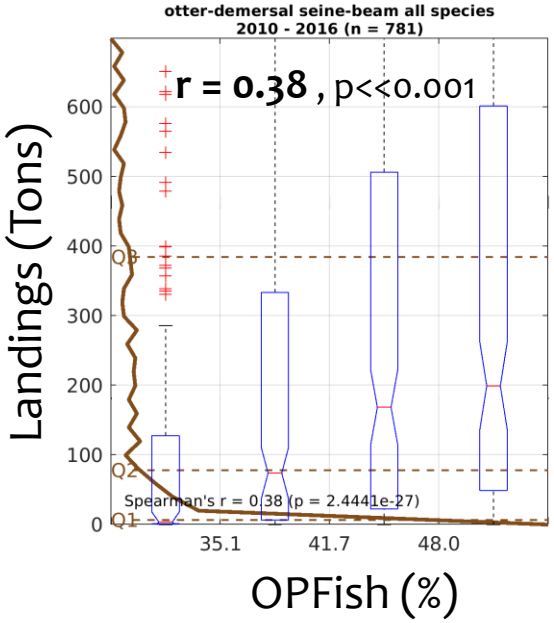
European Commission

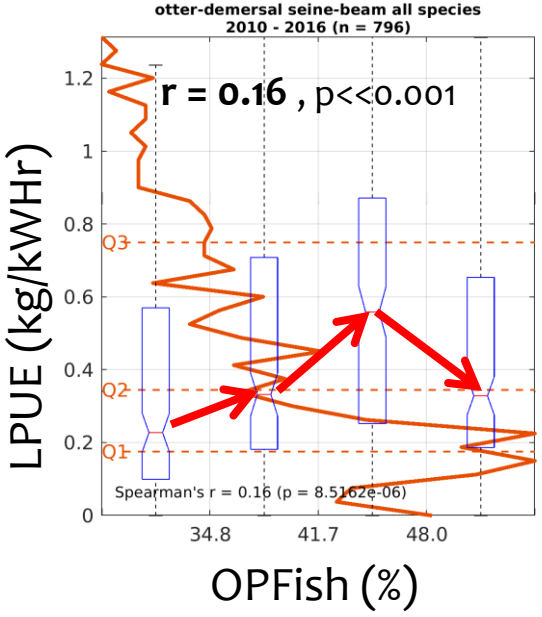
Mobile bottom gears

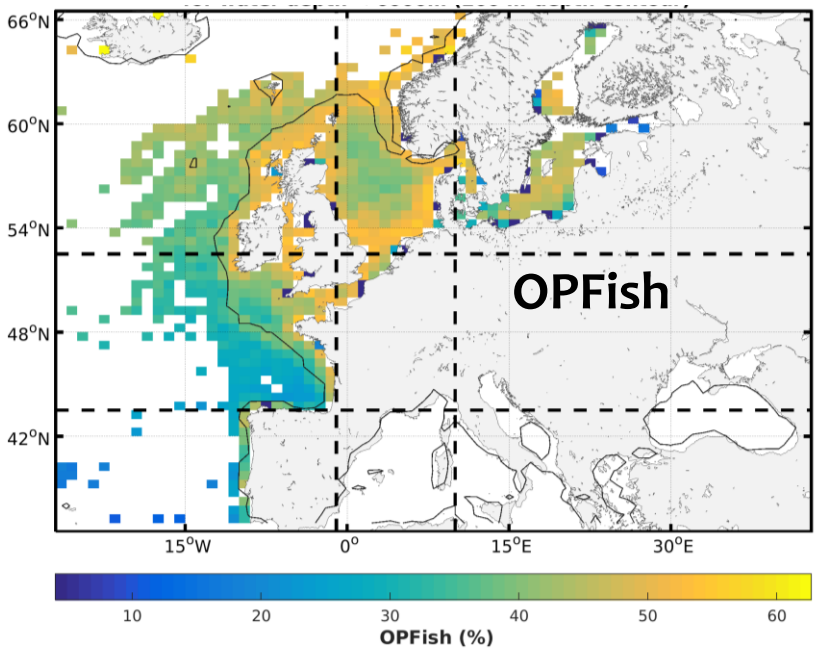
(bottom otter-demersal seine- beam)

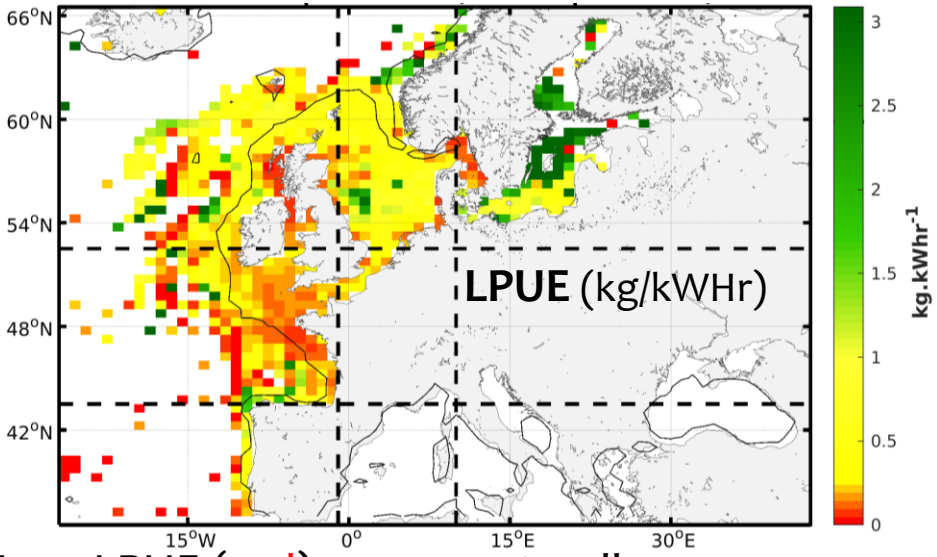
All species
By quarter











Low LPUE (red) means naturally poor area or potentially over-exploited

European Commission

Normalized LPUE/OPFish ratio
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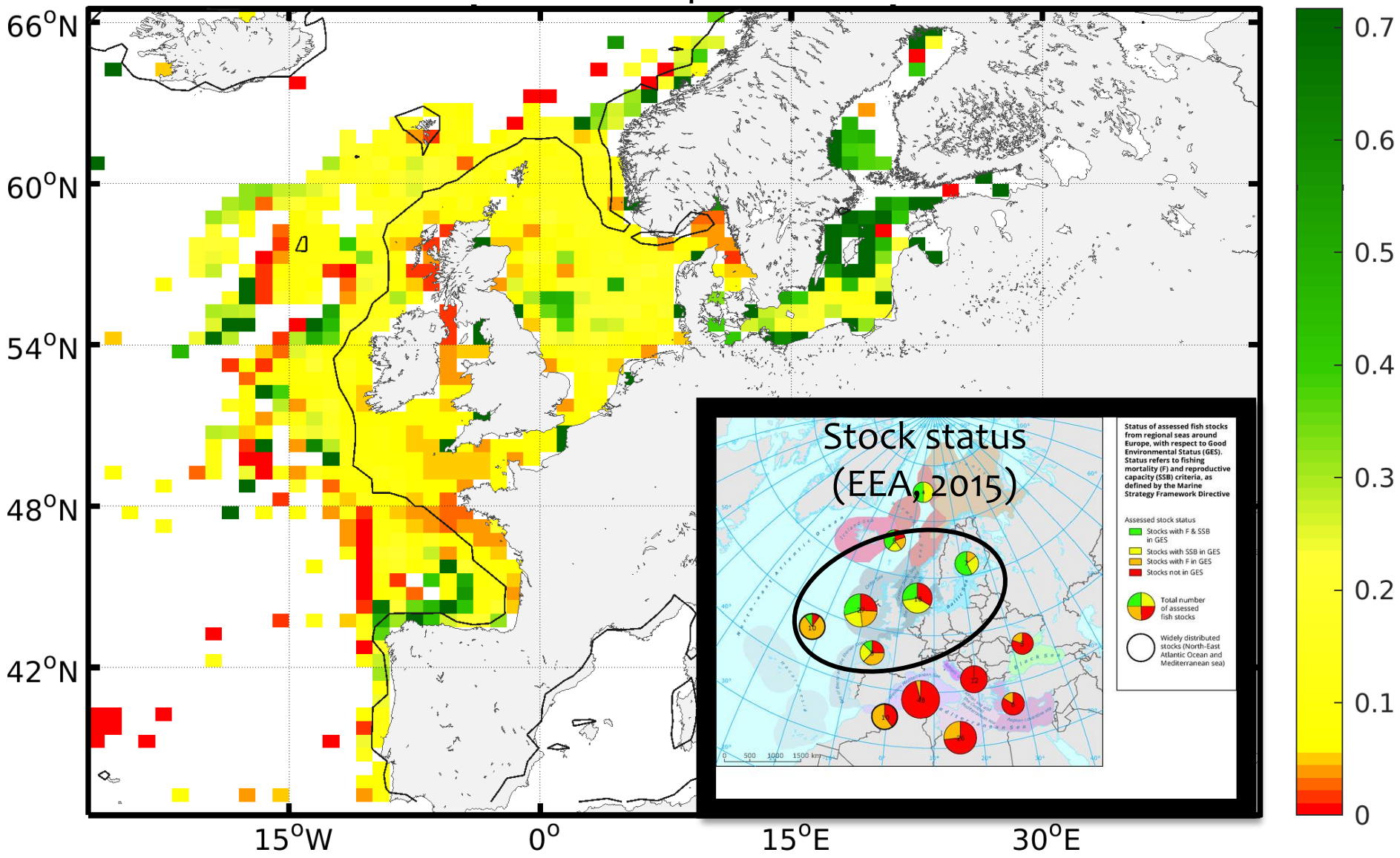
In logarithm form for LPUE
Max colorbar= perc.95th



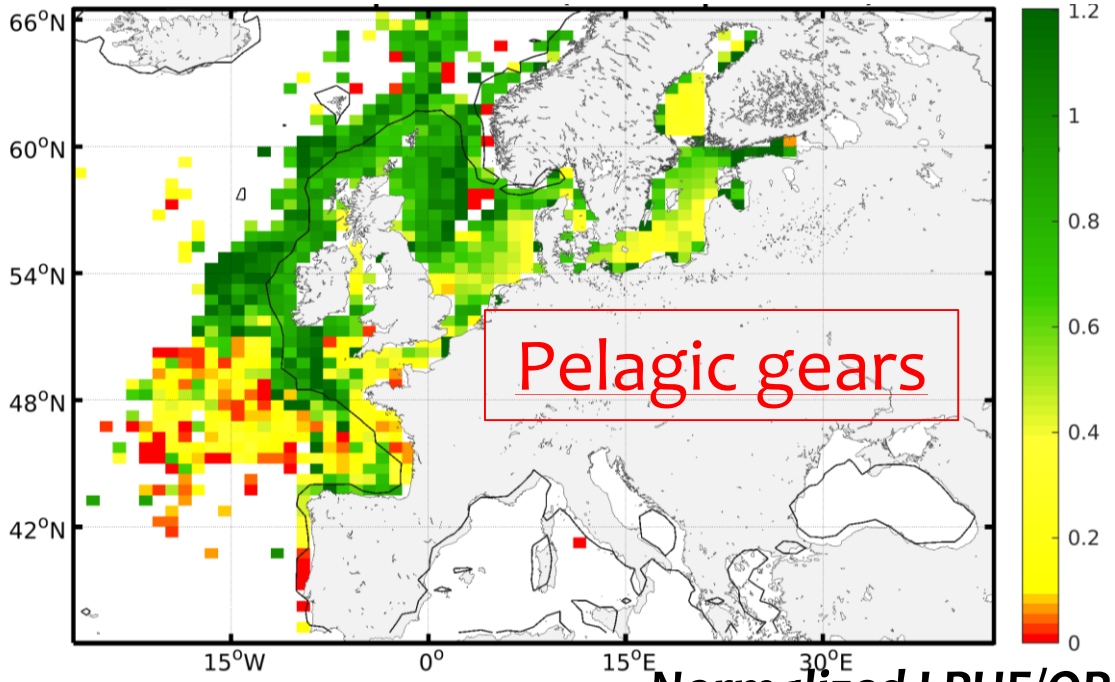
Potentially healthy exploitation

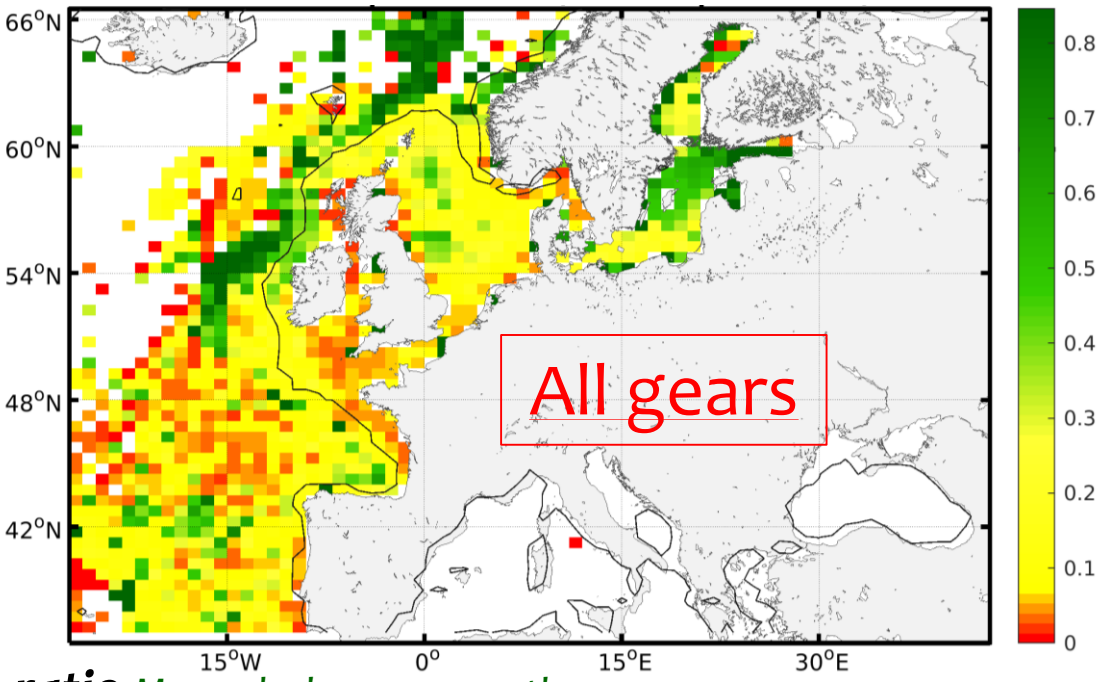
Mobile bottom gears
(bottom otter-demersal seine- beam)

All species
By quarter

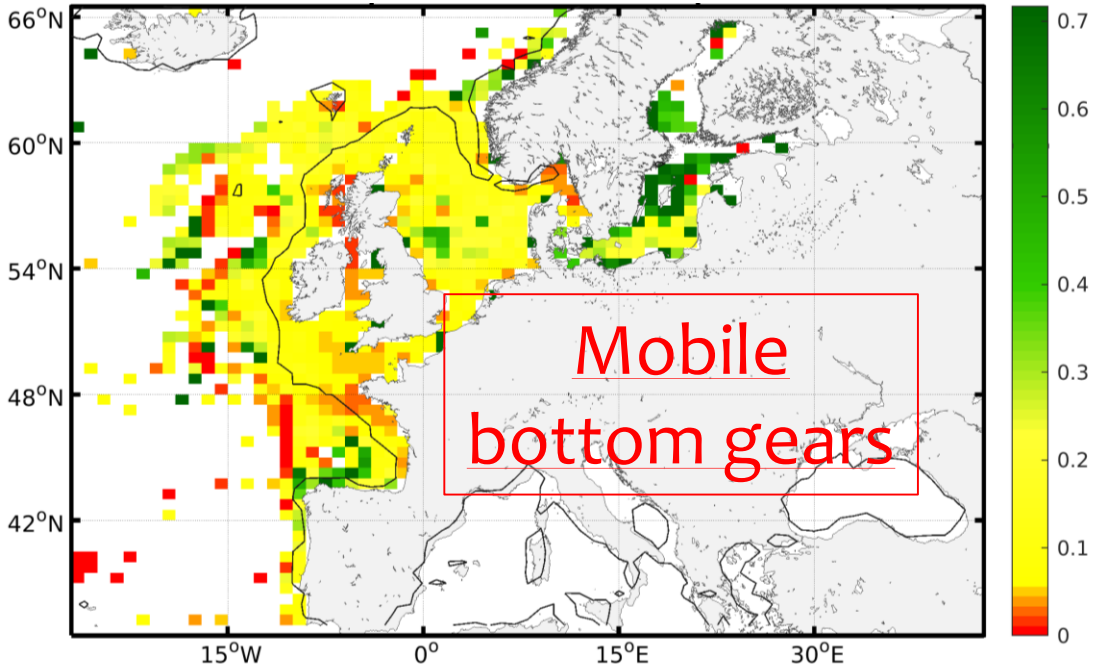
Potentially over-exploited

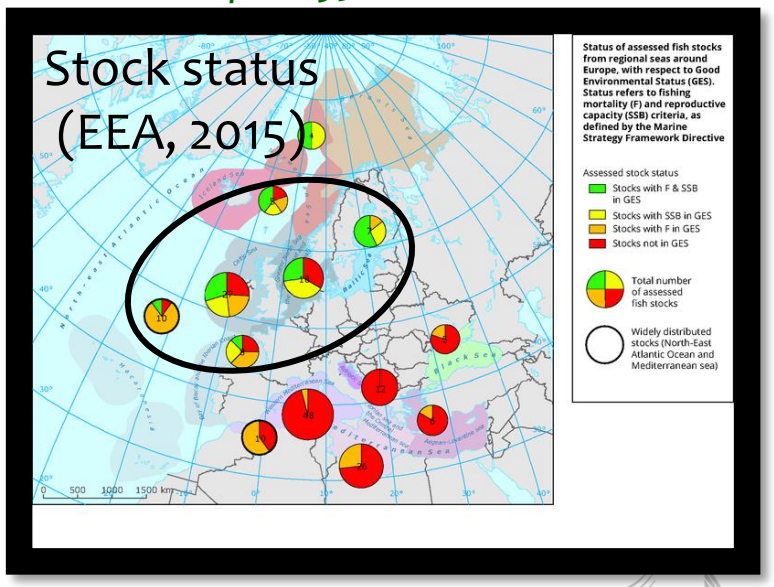
European Commission



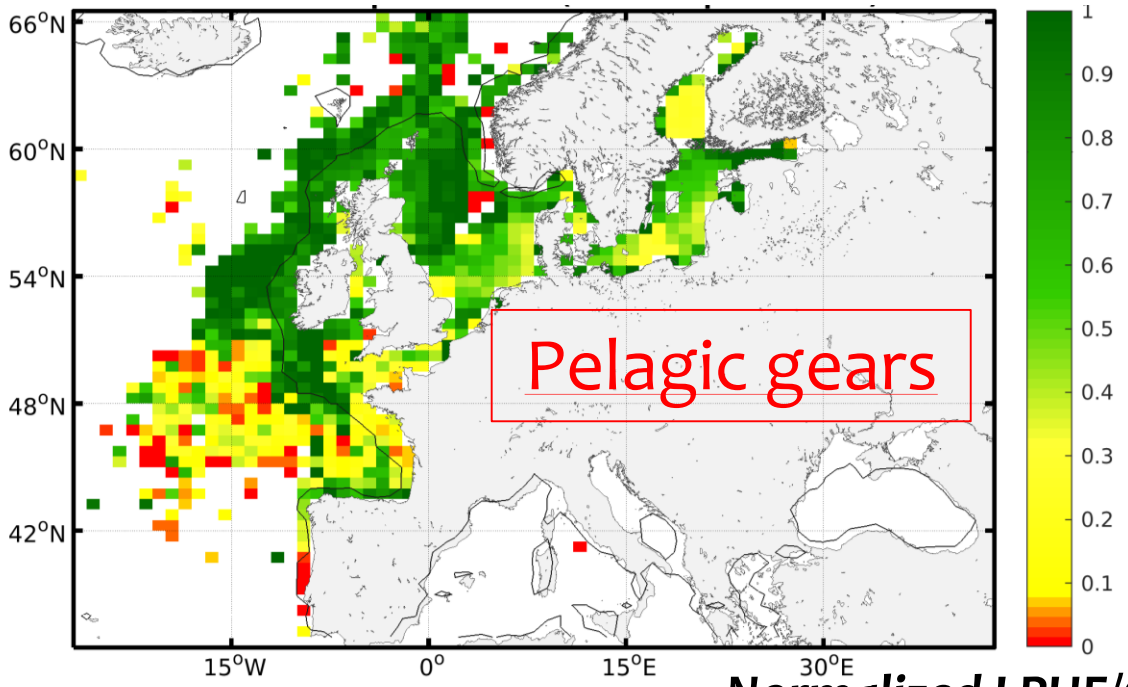


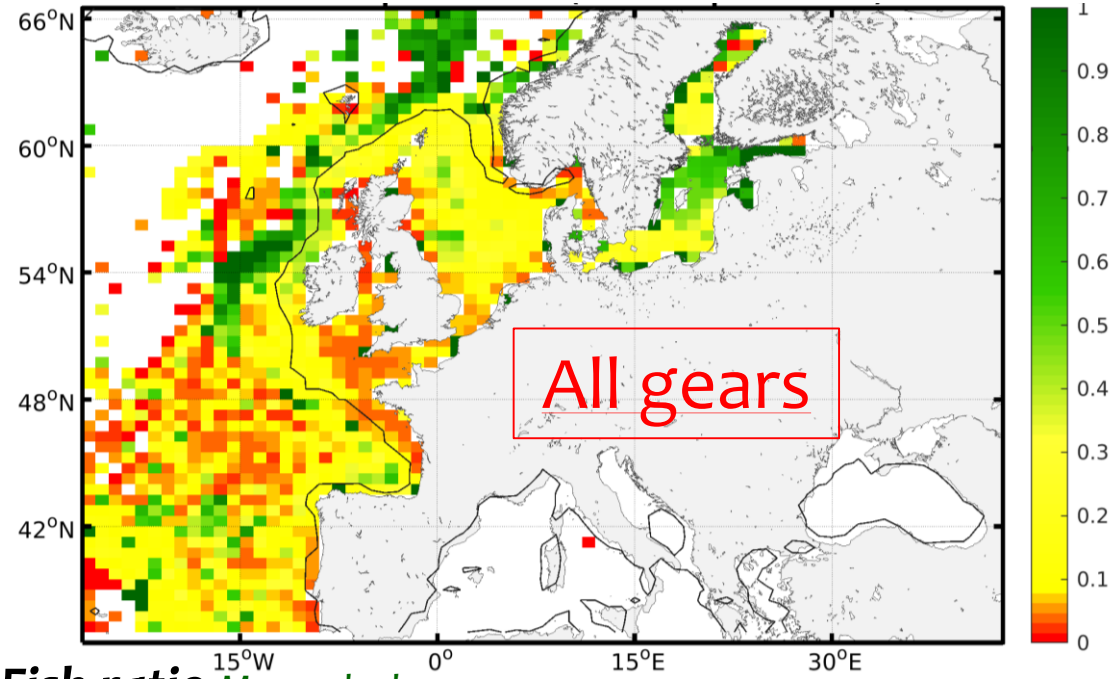
Normalized LPUE/OPFish ratio *Max colorbar= perc.95th*



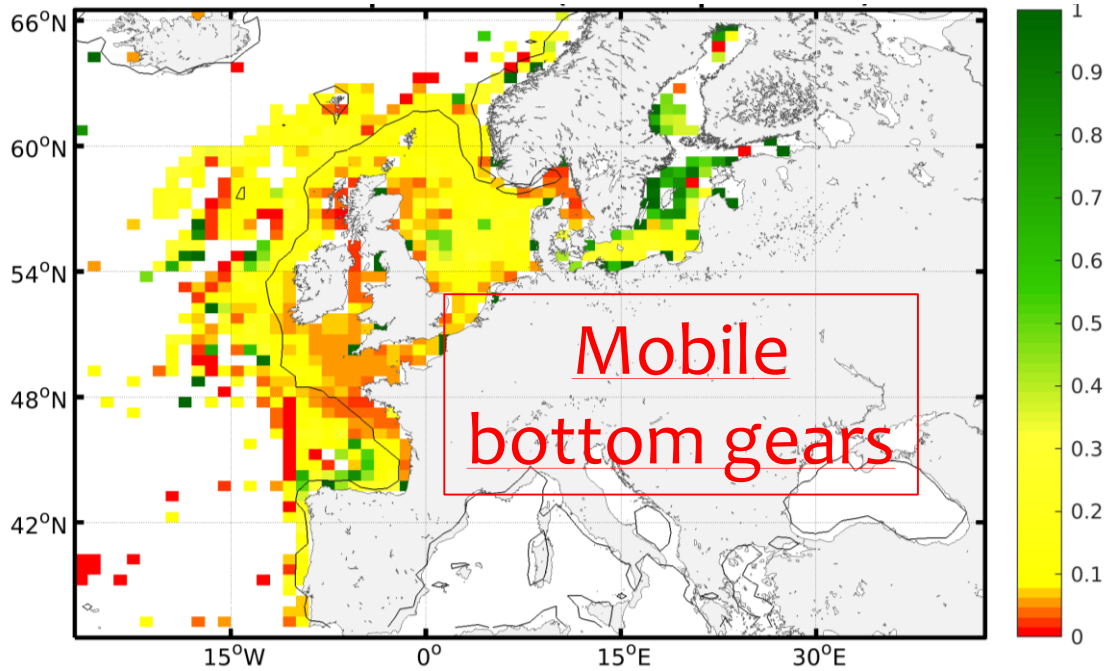


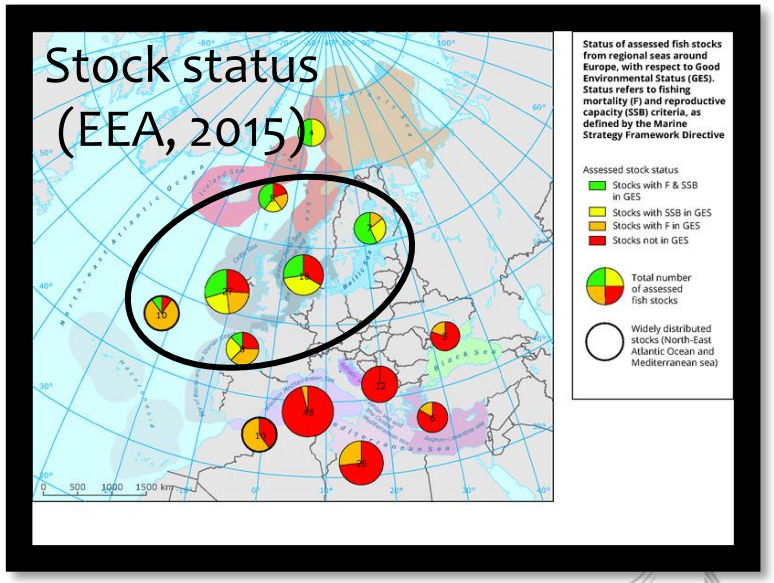
European Commission





Normalized LPUE/OPFish ratio *Max colorbar= 1*





European Commission

OPFish *vs* ICES WGSFD (annual 2009-2016, 0.05x0.05 deg.)

Seek best correlation of OPFish with:

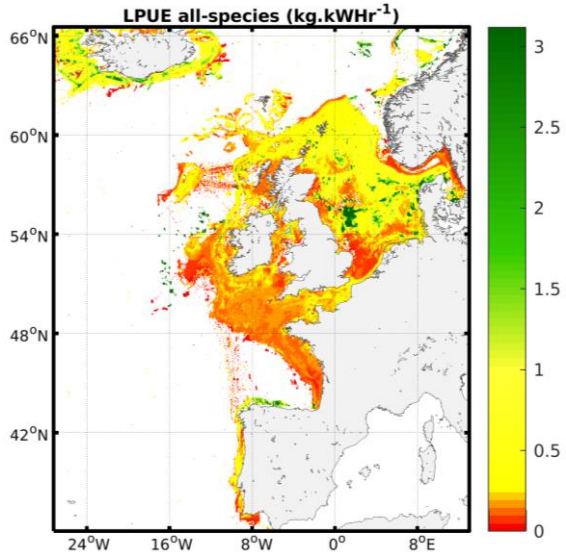
- **Fishing effort** (kWHr), **Landings** (tons), **LPUE**.
- **Gear groups:**
  - ✓ Demersal mobile gears – otter + demersal seine + beam,

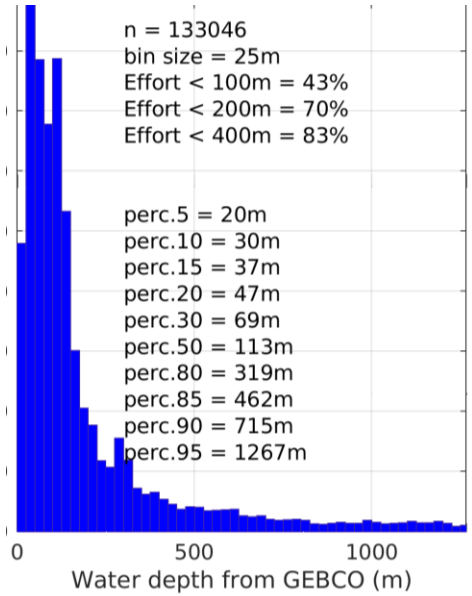
- Data distributed in various **water depth**: all depths, < 400 m, < 200 m:

  BUT all results are shown for all depths for comparison with DCF
  (lower correlation coefficient for demersal/pelagic gears, r_s difference < 0.16)

- **OPFish integration time** before a given year (including it) from 12 to 48 months:
  - ✓ differences in r_s <0.02,
  - ✓ generally a correlation peak for ~14 months.

- Comparison with DCF data at 0.5x1 deg.

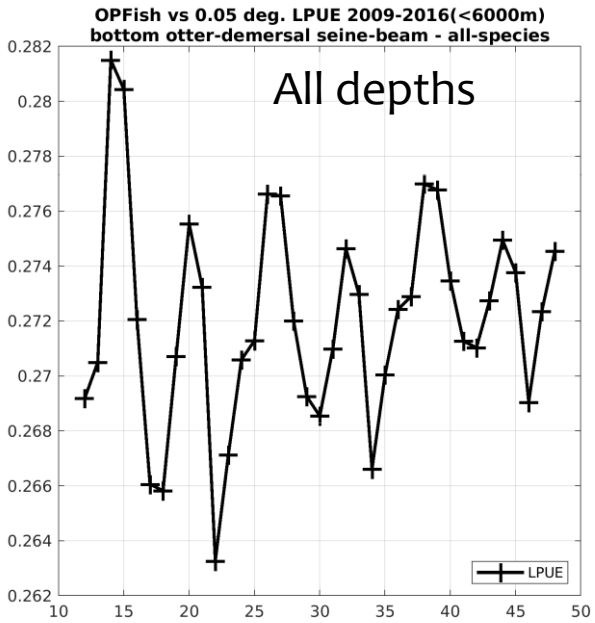


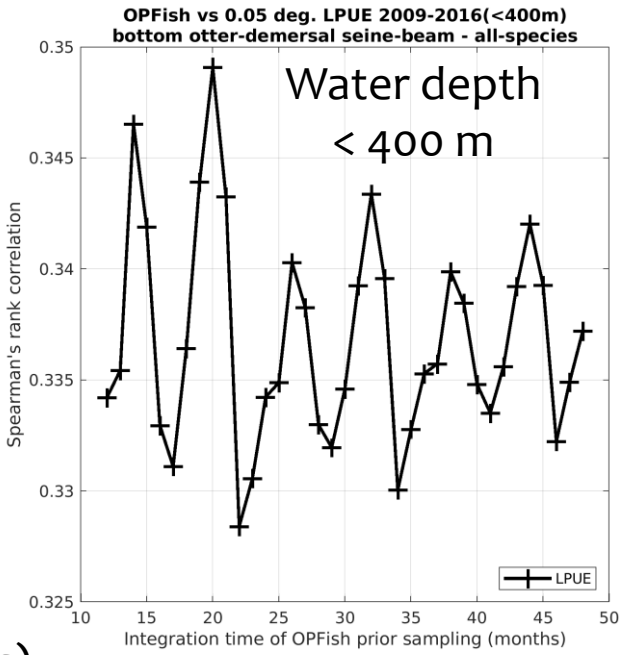


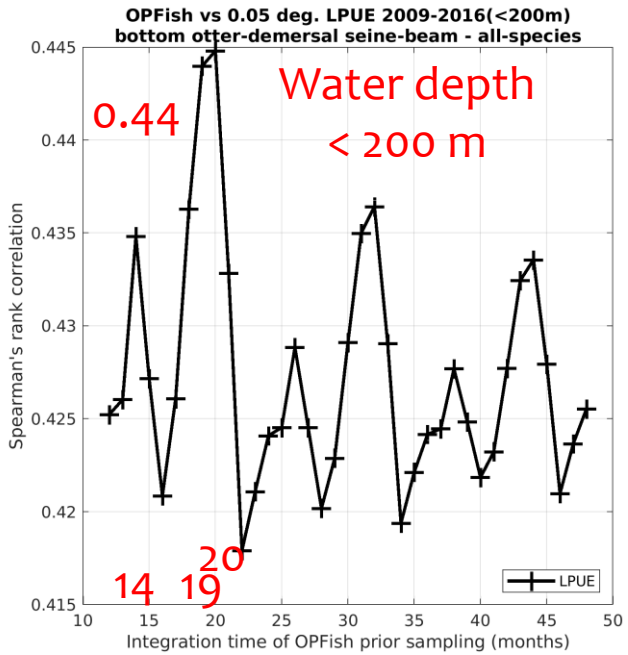
European Commission

ICES WGSFD 0.05 deg. demersal gears LPUE correlation with OPFish increasing integration time

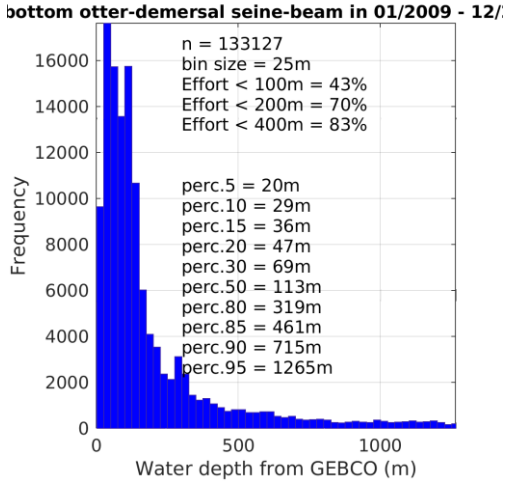
Spearman's correlation r_s







OPFish integration time (months)



ICES WGSFD 0.05 deg. demersal gears

Highest correlation for:

- Depth < 200 m (0.44)
- OPFish integration time (first peaks)
  - ✓ <200 m: 19, 20, **14** months
  - ✓ <400m: **14**, 20 months
  - ✓ All depths: **14**, 15 months

-> more stringent link with OPFish for shallow depth

European Commission

OPFish *vs* ICES WGSFD

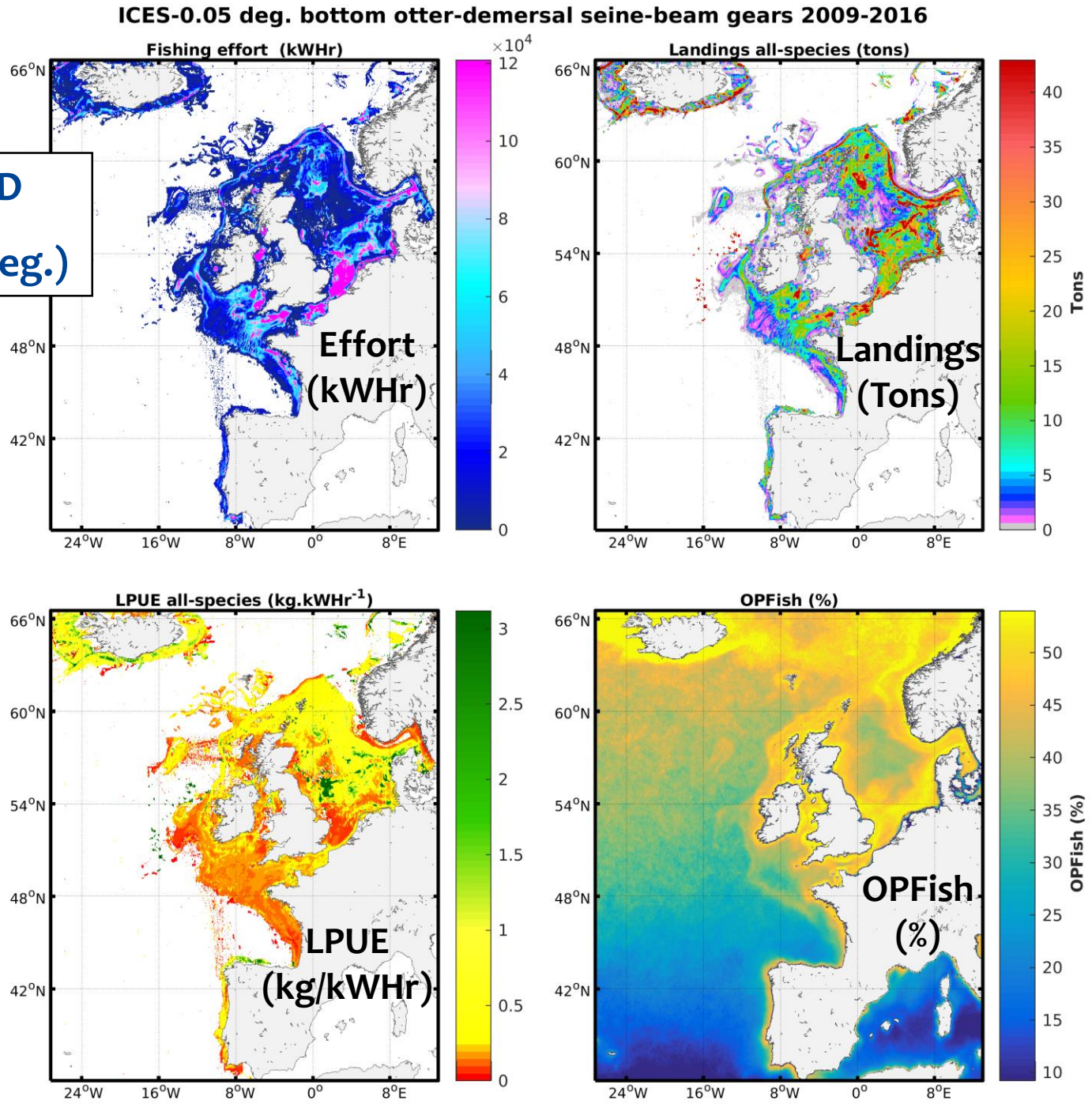
(2009-2016, 0.05x0.05 deg.)

Mobile bottom gears

(bottom otter-demersal seine- beam)

All species

By year



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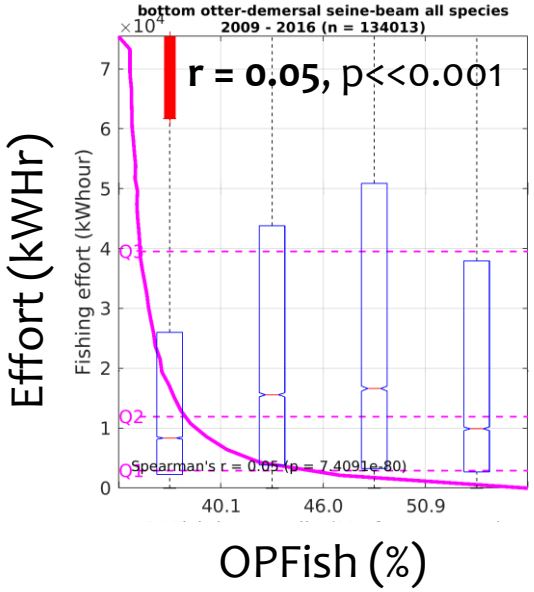
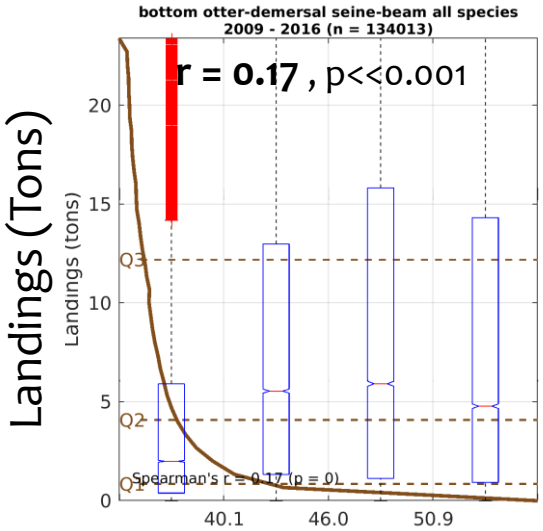
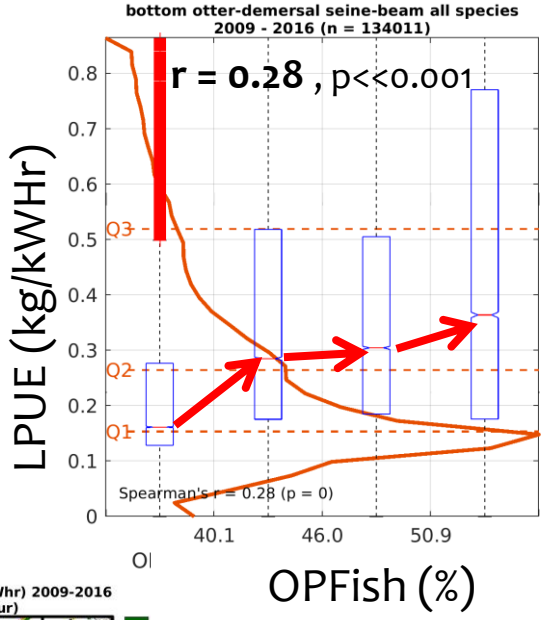
Mobile bottom gears

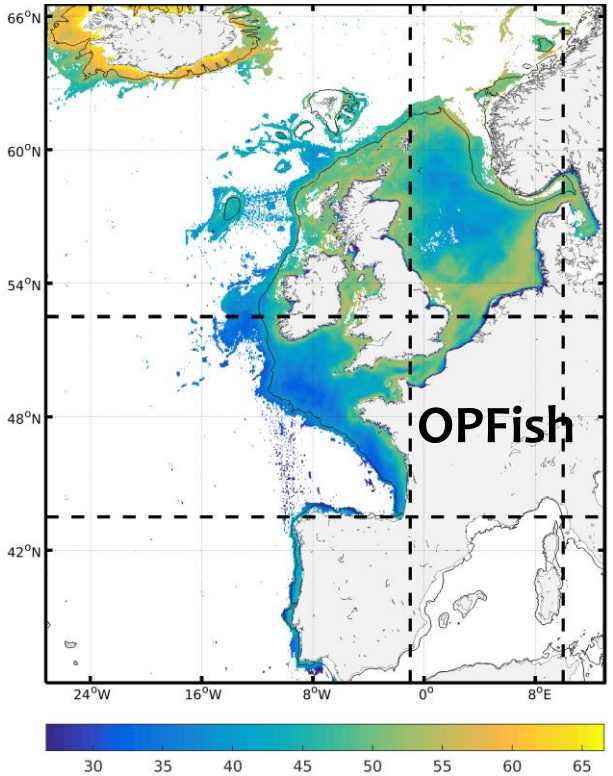
(bottom otter-demersal seine- beam)

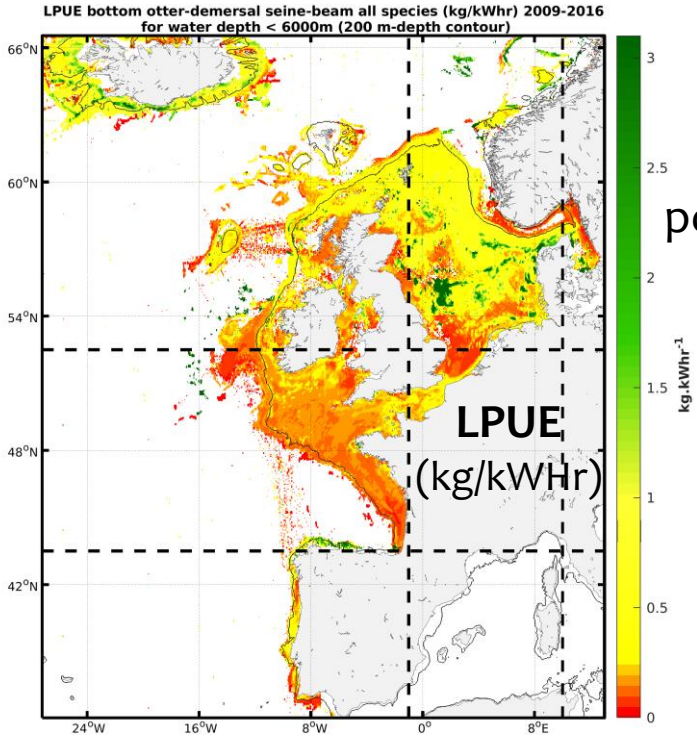
All species
By quarter











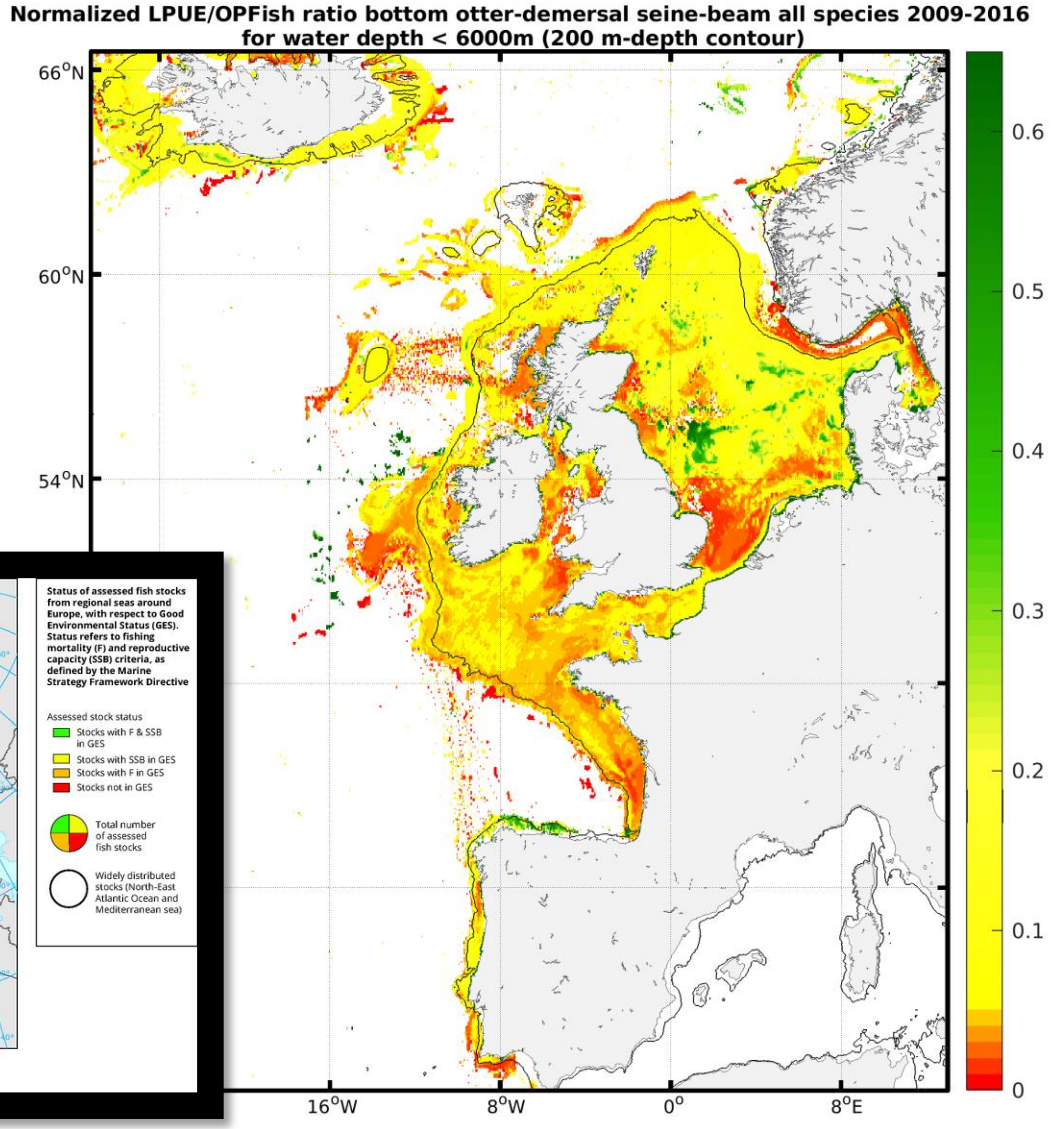
Low LPUE (red) means naturally poor area or potentially over-exploited

Higher correlation than for DCF LPUE (0.5x1 deg.) (r_s = 0.28/0.16) :

- **Effect of resolution (0.05 deg.) as regards to high spatial contrasts?**

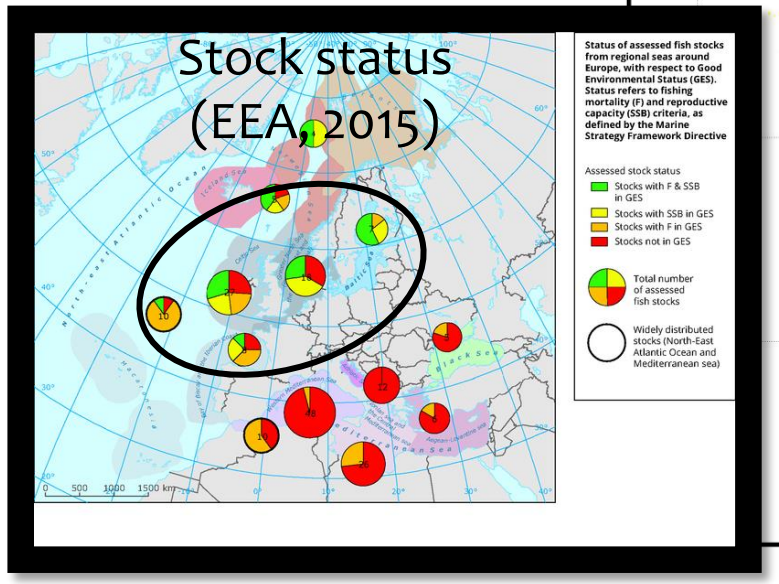
European Commission

Normalized LPUE/OPFish ratio
= Effective fishing yield / Potential fishing yield
= exploitation status?



Potentially healthy exploitation

Potentially over-exploited

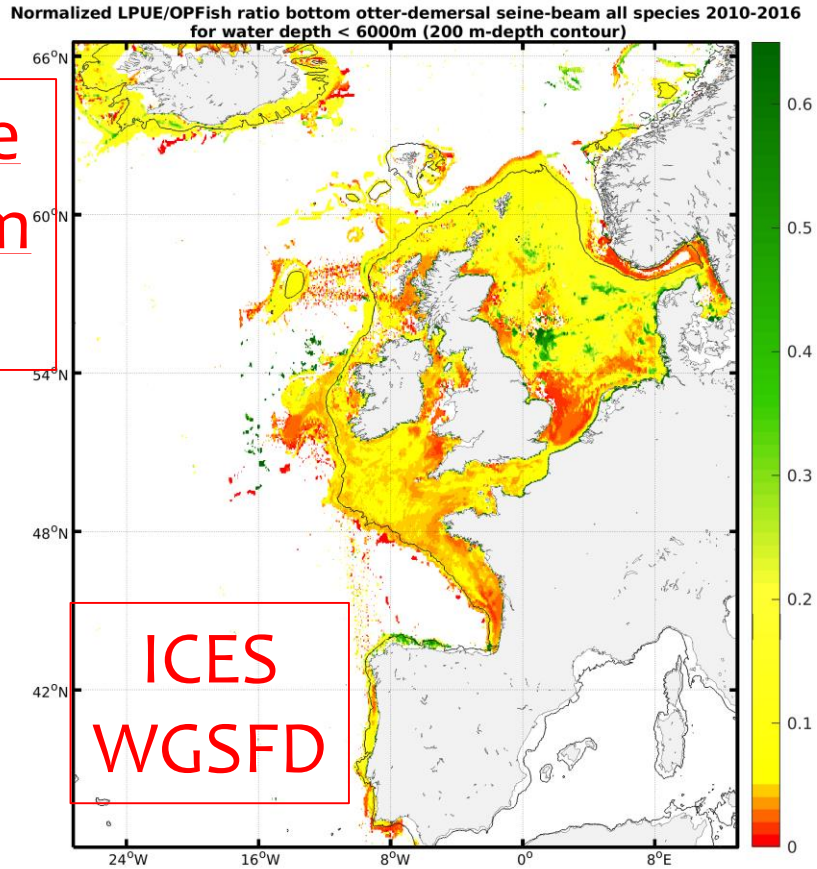


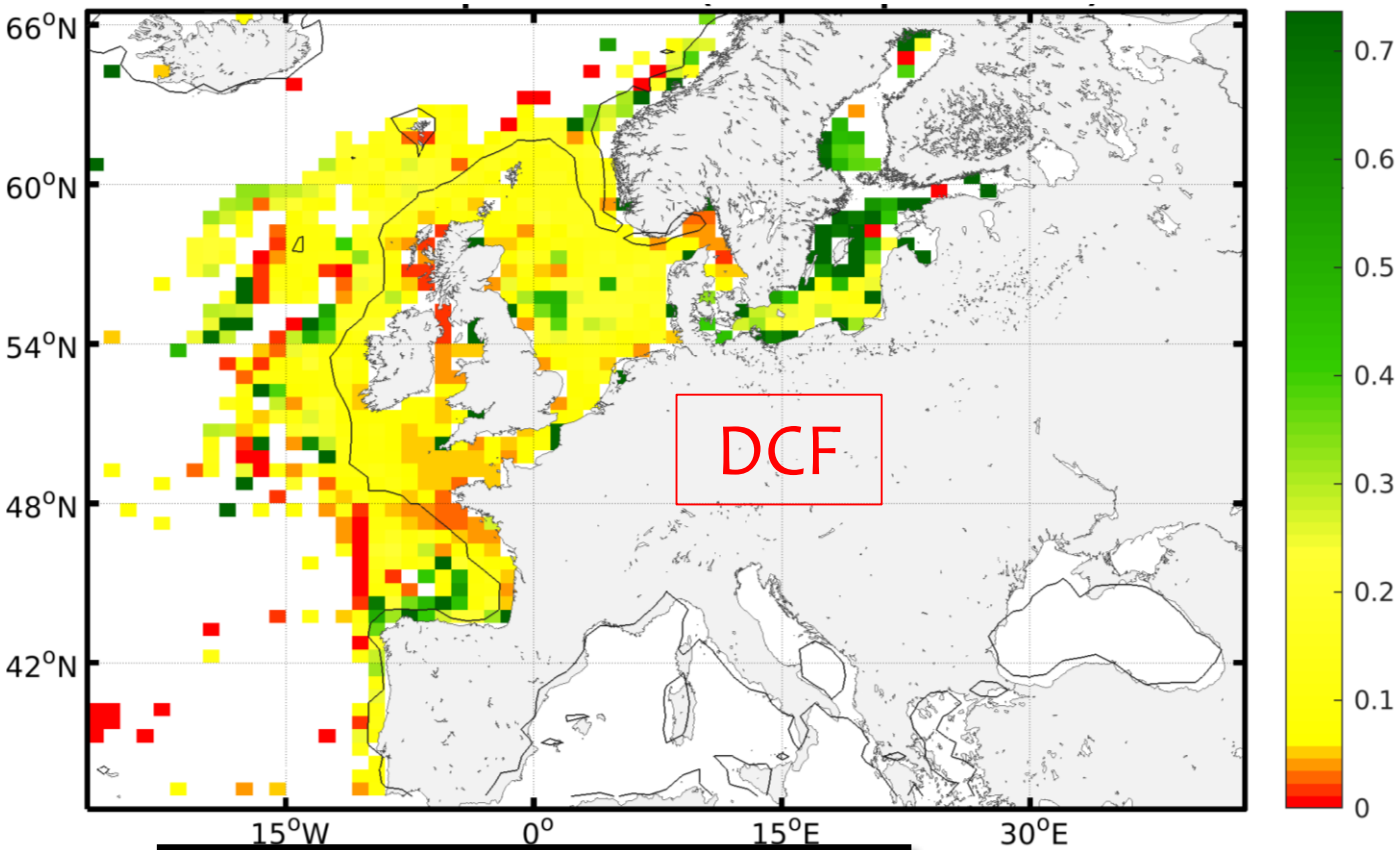
Mobile bottom gears
(bottom otter-demersal seine- beam)

All species
By year

European Commission

Mobile bottom gears

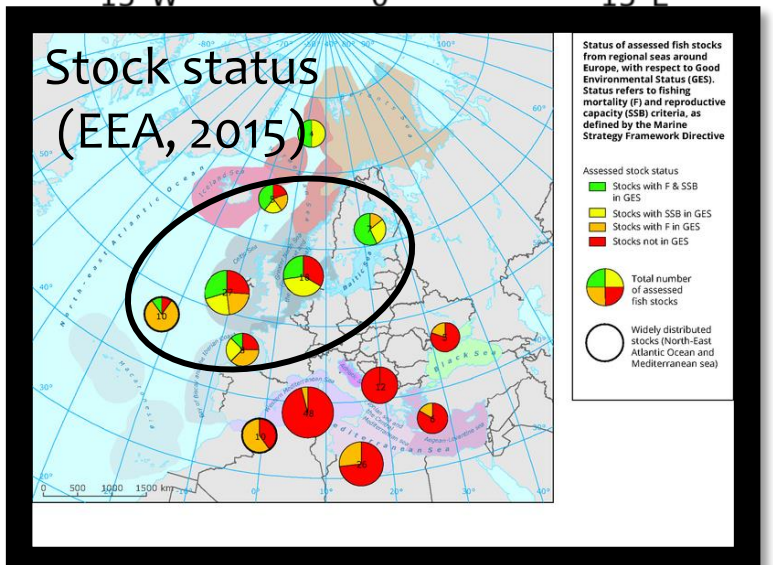




Normalized LPUE/OPFish ratio – 0 to 0.72 colourbar

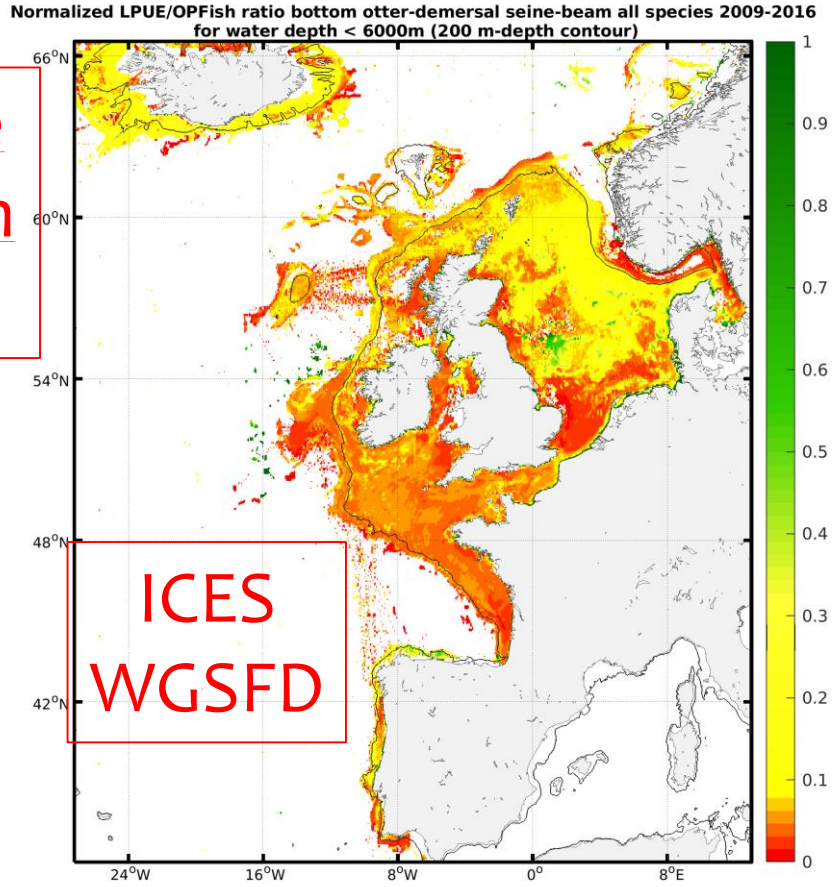
General consistency except:

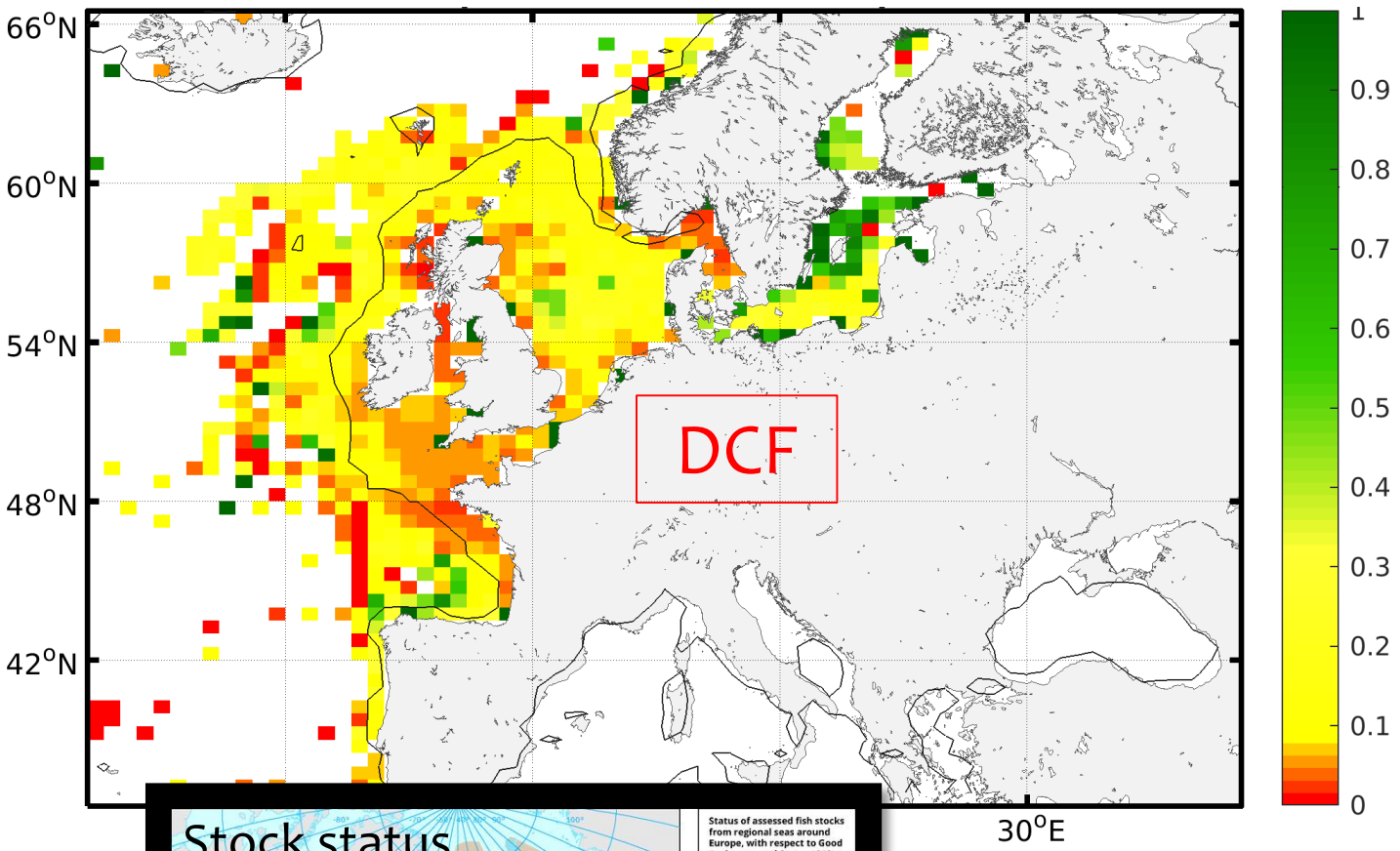
- ***North/south BoB -> lack of Spanish data***
- ***<u>Southern North Sea?? (higher effort and lower landings in ICES WGSFD)</u>***



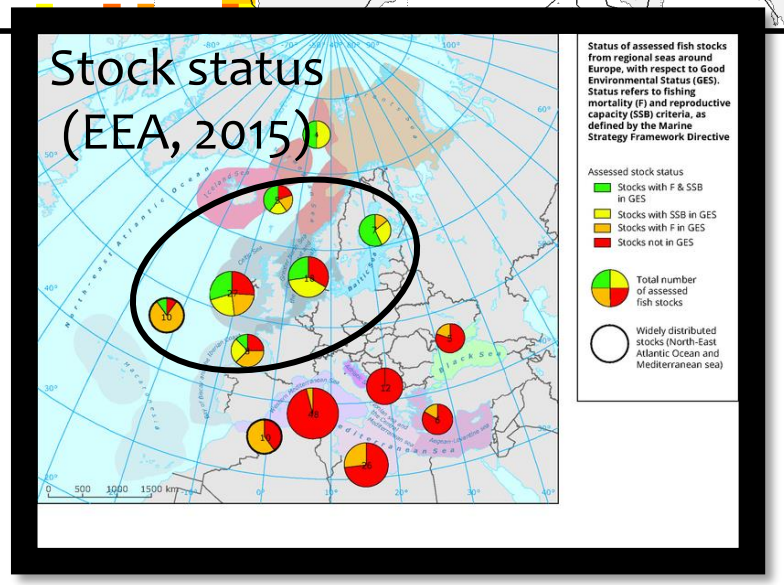
European Commission

Mobile bottom gears





Normalized LPUE/OPFish ratio – 0 to 1 colourbar



General consistency except:

- ***North/south BoB -> lack of Spanish data (0.05 deg.)***
- ***<u>Southern North Sea?? (higher effort and lower landings in ICES WGSFD)</u>***

European Commission

TIME ANALYSIS

Effort, landings, LPUE, OPFish from 2009/2010 to 2016 (WGSFD and DCF):

- Time-series integrating the whole area per year,
- Trend maps using the linear slope computed from annual values.

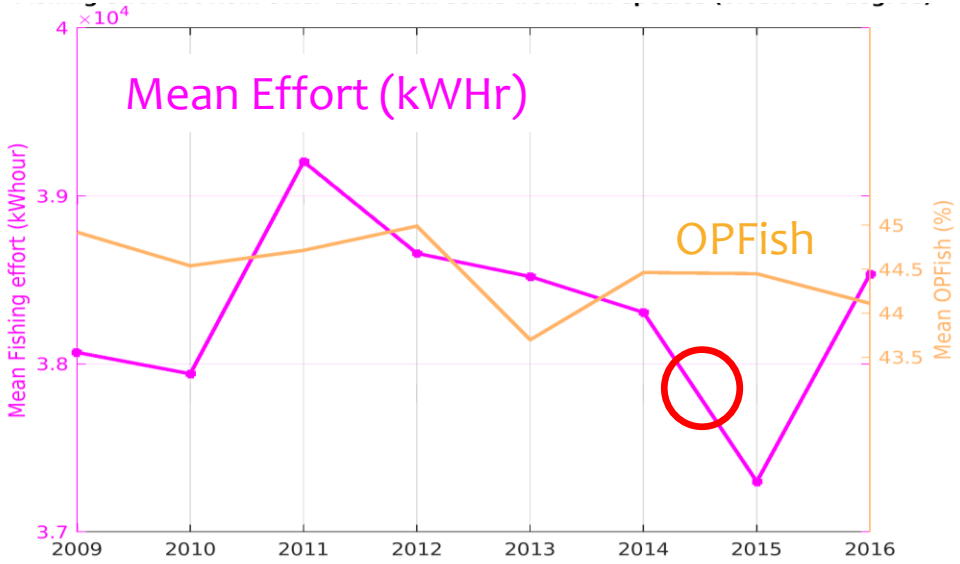
TIME-SERIES

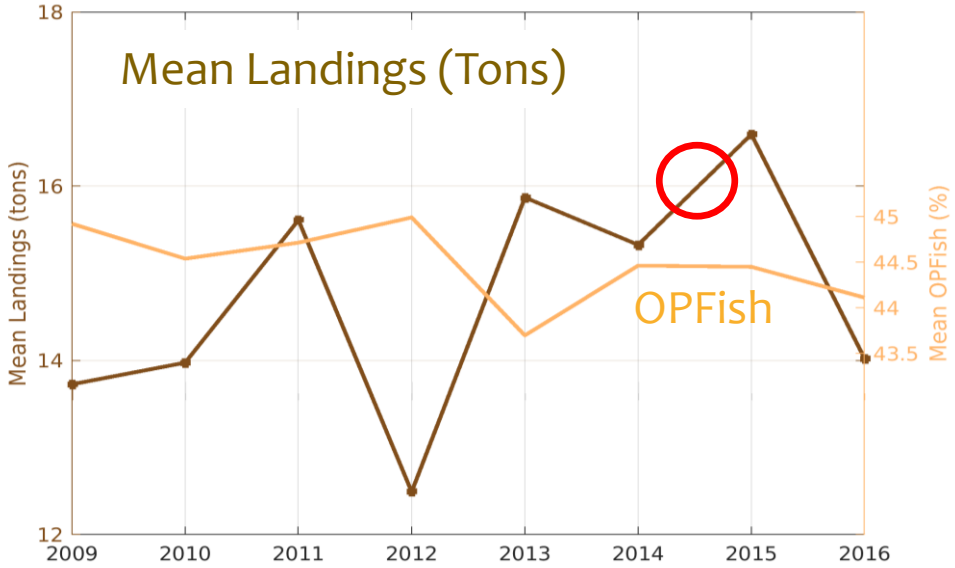
OPFish *vs* ICES WGSFD

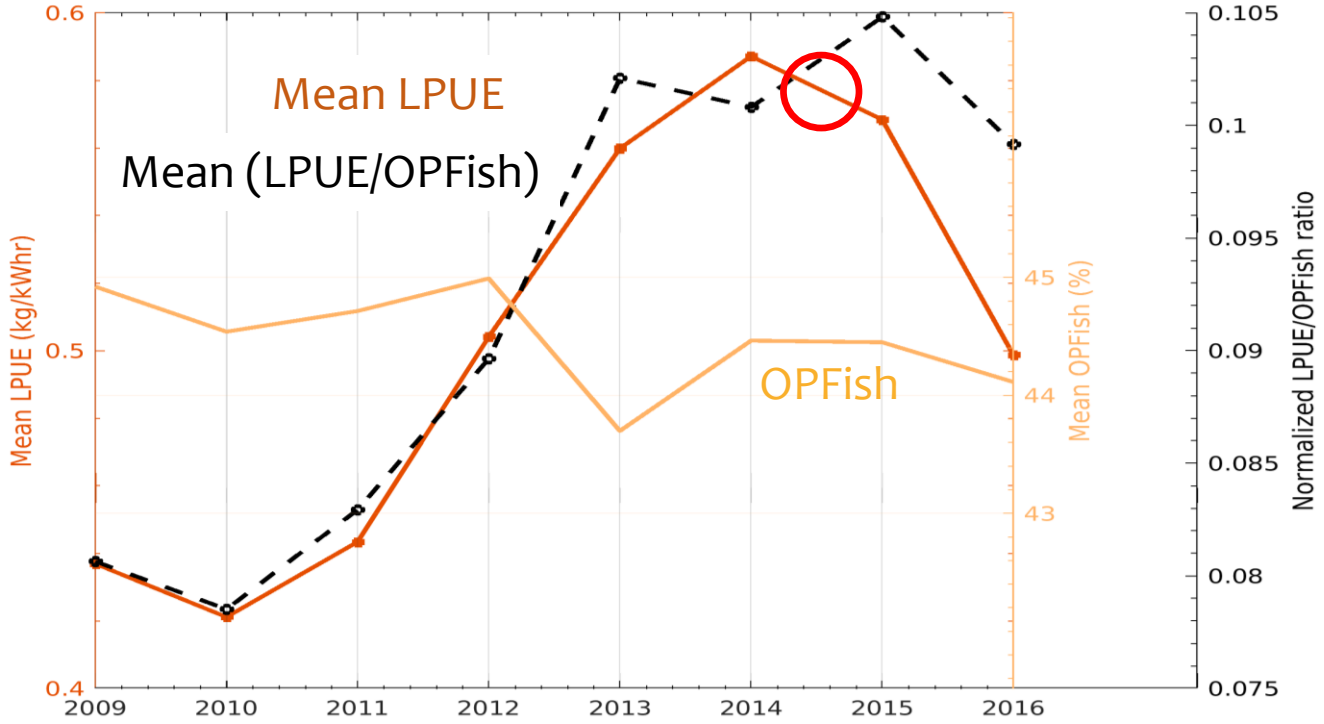
(2009-2016, 0.05x0.05 deg.)

Mobile bottom gears (bottom otter-demersal seine- beam)

All species By year







-> Excessive spatial integration makes the interpretation difficult (e.g. 2014-2015)

European Commission

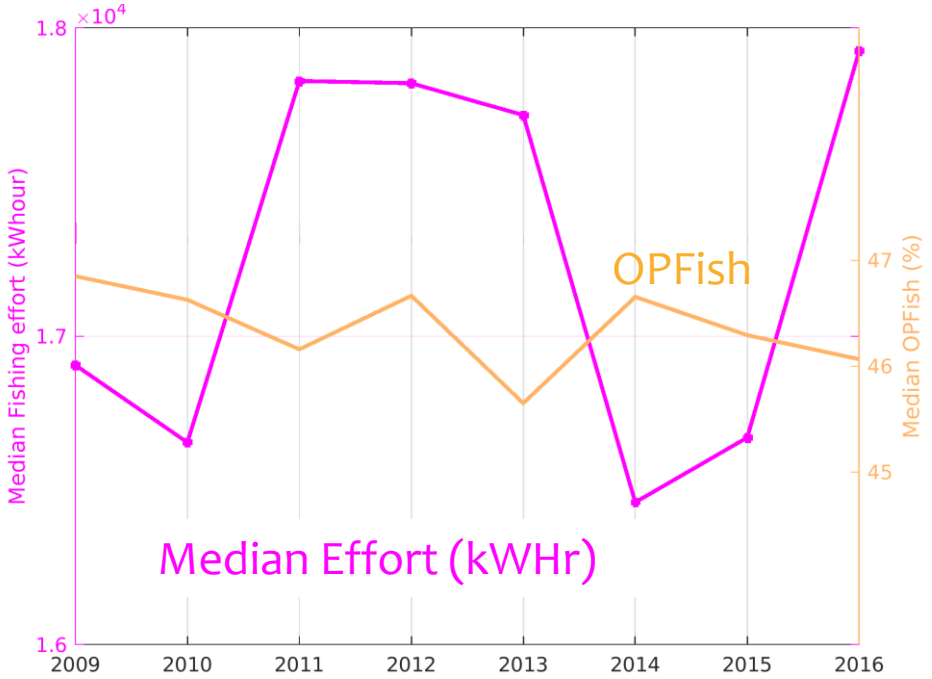
TIME-SERIES

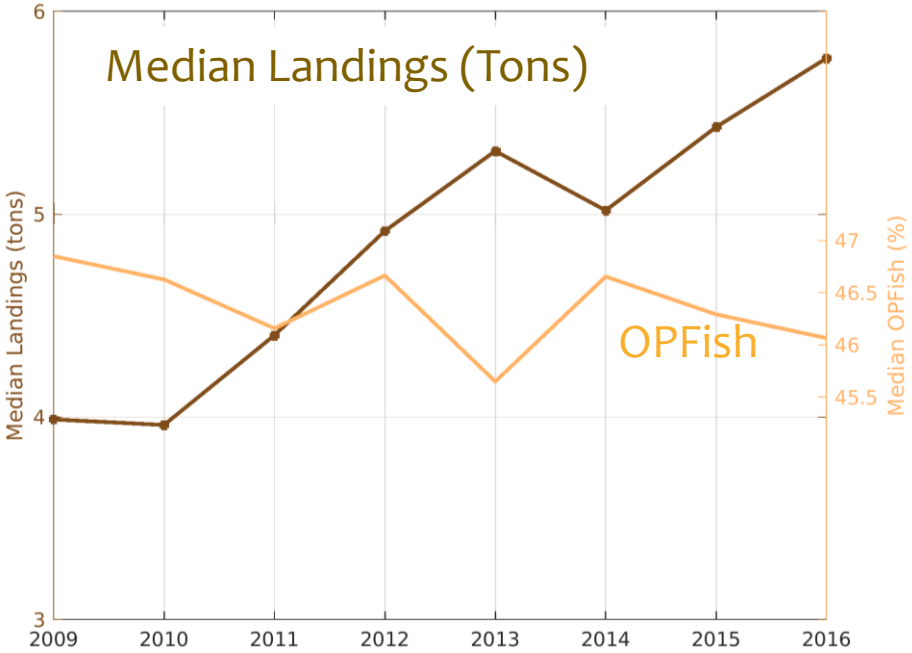
OPFish *vs* ICES WGSFD

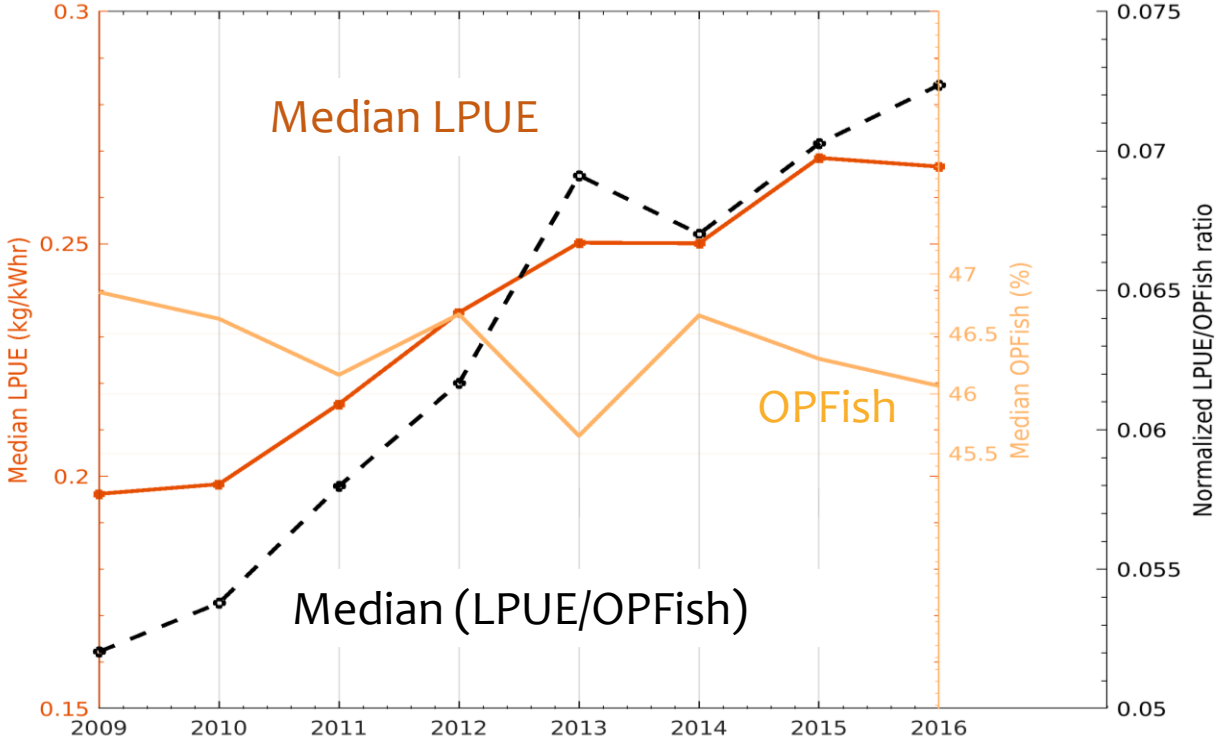
(2009-2016, 0.05x0.05 deg.)

Mobile bottom gears (bottom otter-demersal seine- beam)

All species By year







-> Median more consistent than mean levels.

European Commission

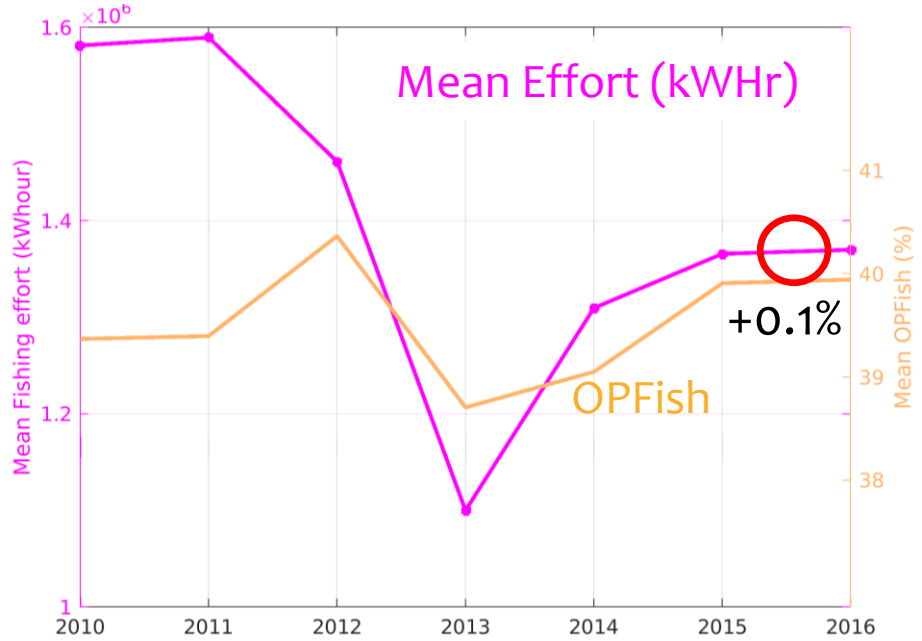
TIME-SERIES

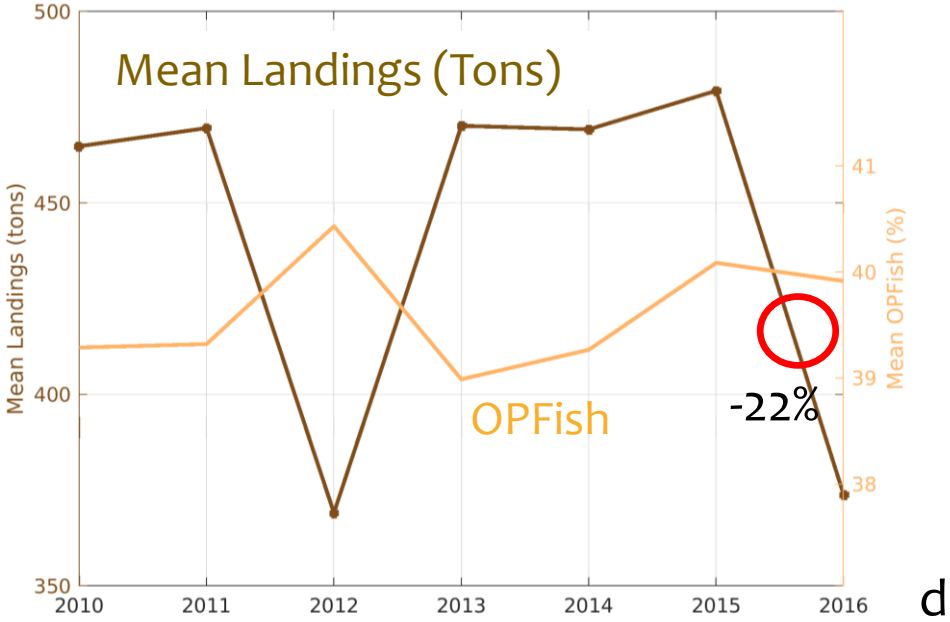
OPFish *vs* DCF ICES rectangles

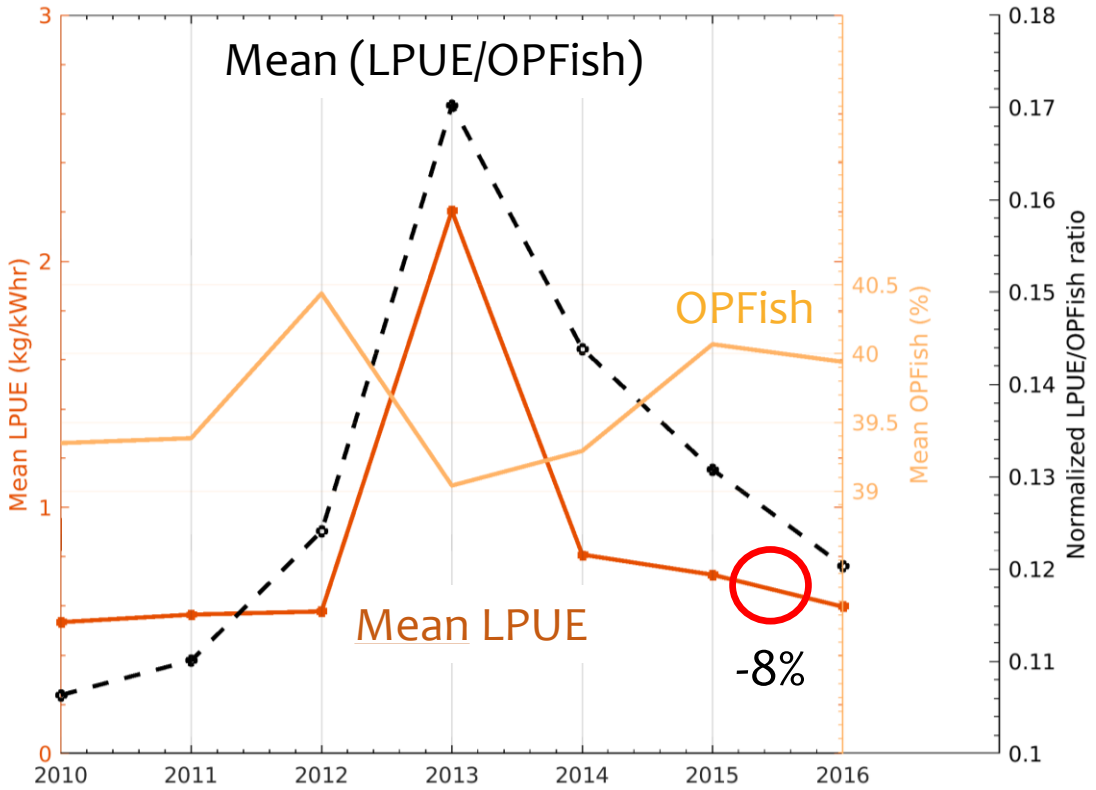
(2010-2016, 0.5x1 deg.)

Mobile bottom gears (bottom otter-demersal seine- beam)

All species **By year**







-> Excessive spatial integration renders difficult the interpretation (e.g. 2015-2016)

European Commission

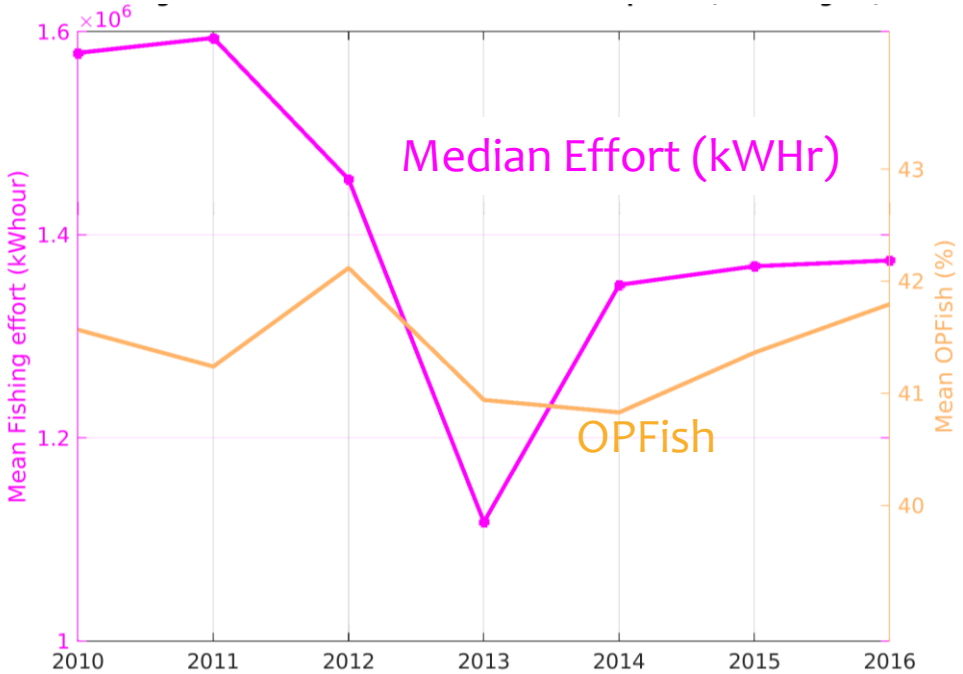
TIME-SERIES

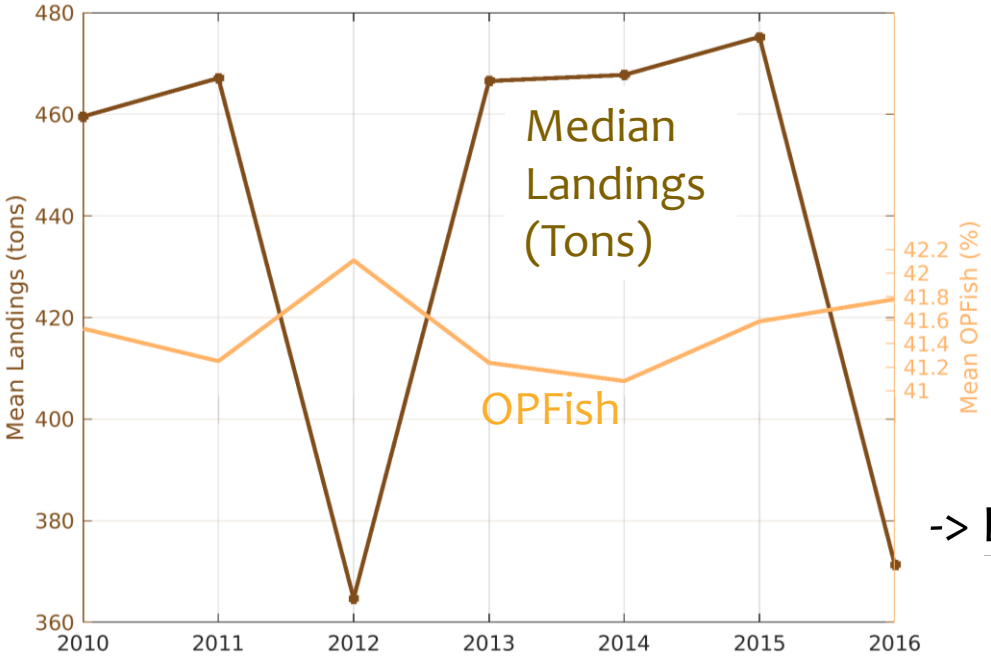
OPFish *vs* DCF ICES rectangles

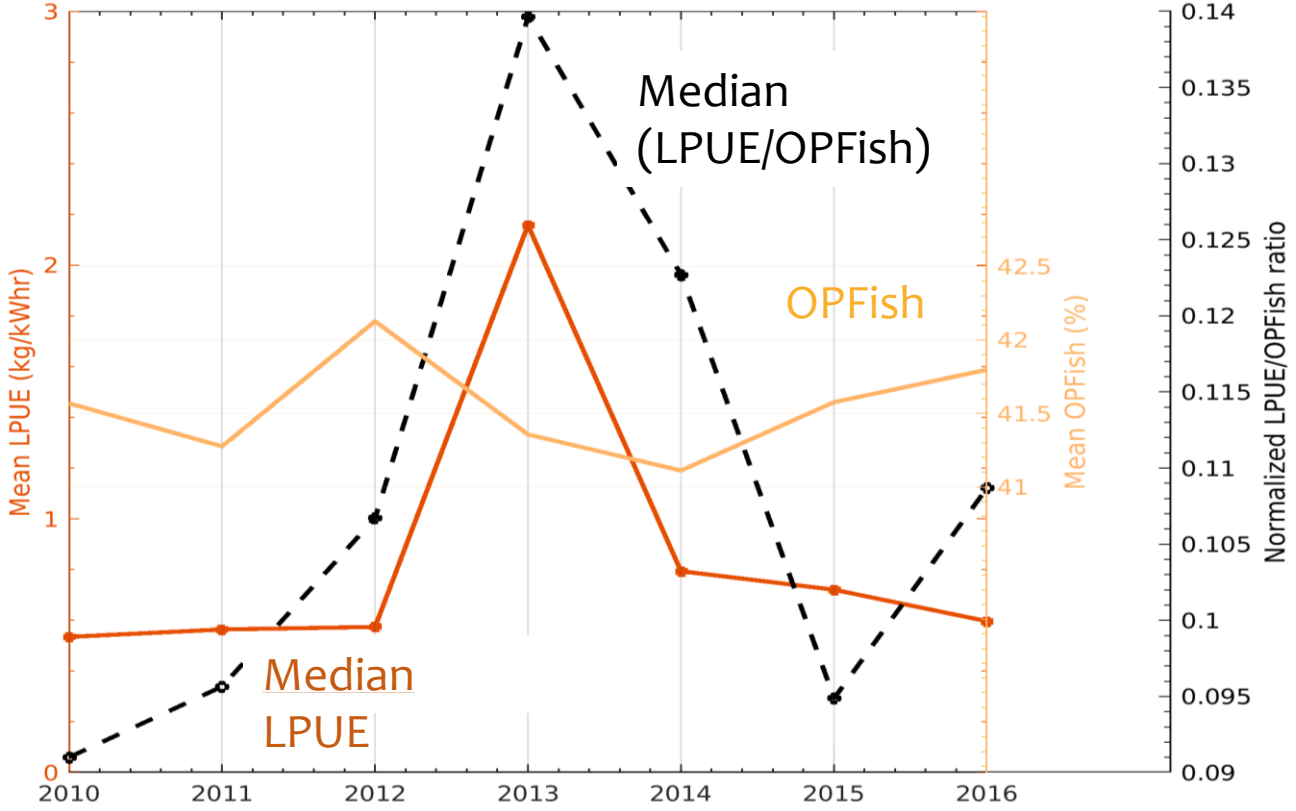
(2010-2016, 0.5x1 deg.)

Mobile bottom gears (bottom otter-demersal seine- beam)

All species **By year**







-> Lower resolution data less sensitive to outliers

European Commission

OPFish *vs* ICES WGSFD

(2009-2016, 0.05x0.05 deg.)

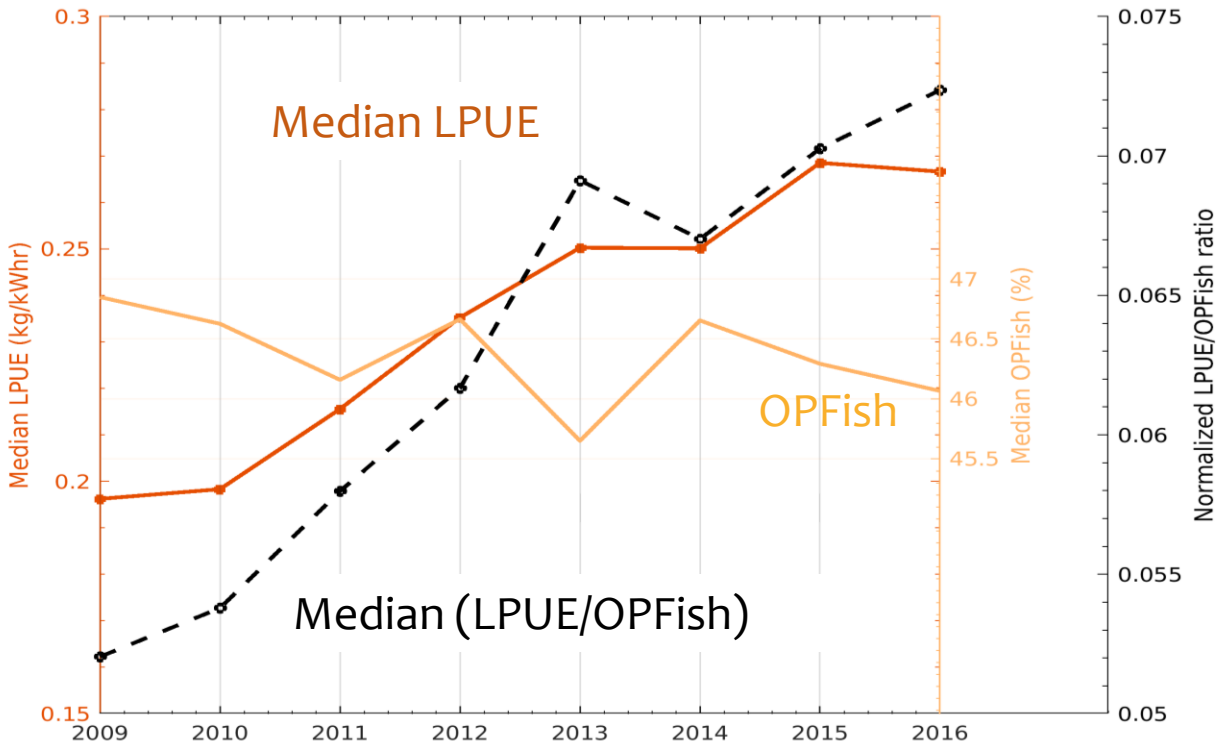
TIME-SERIES

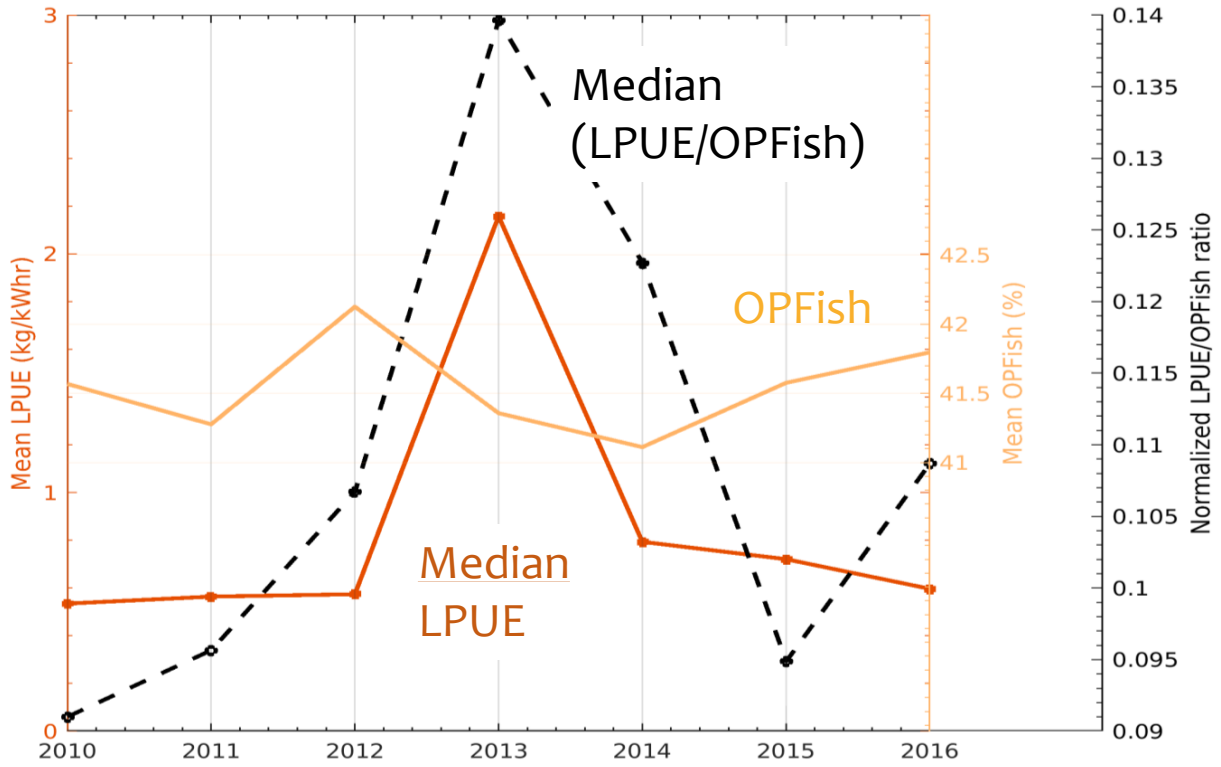
OPFish *vs* DCF ICES rectangles

(2010-2016, 0.5x1 deg.)

Mobile bottom gears (bottom otter-demersal seine- beam)

All species **By year**





-> Inconsistency between different data resolution.

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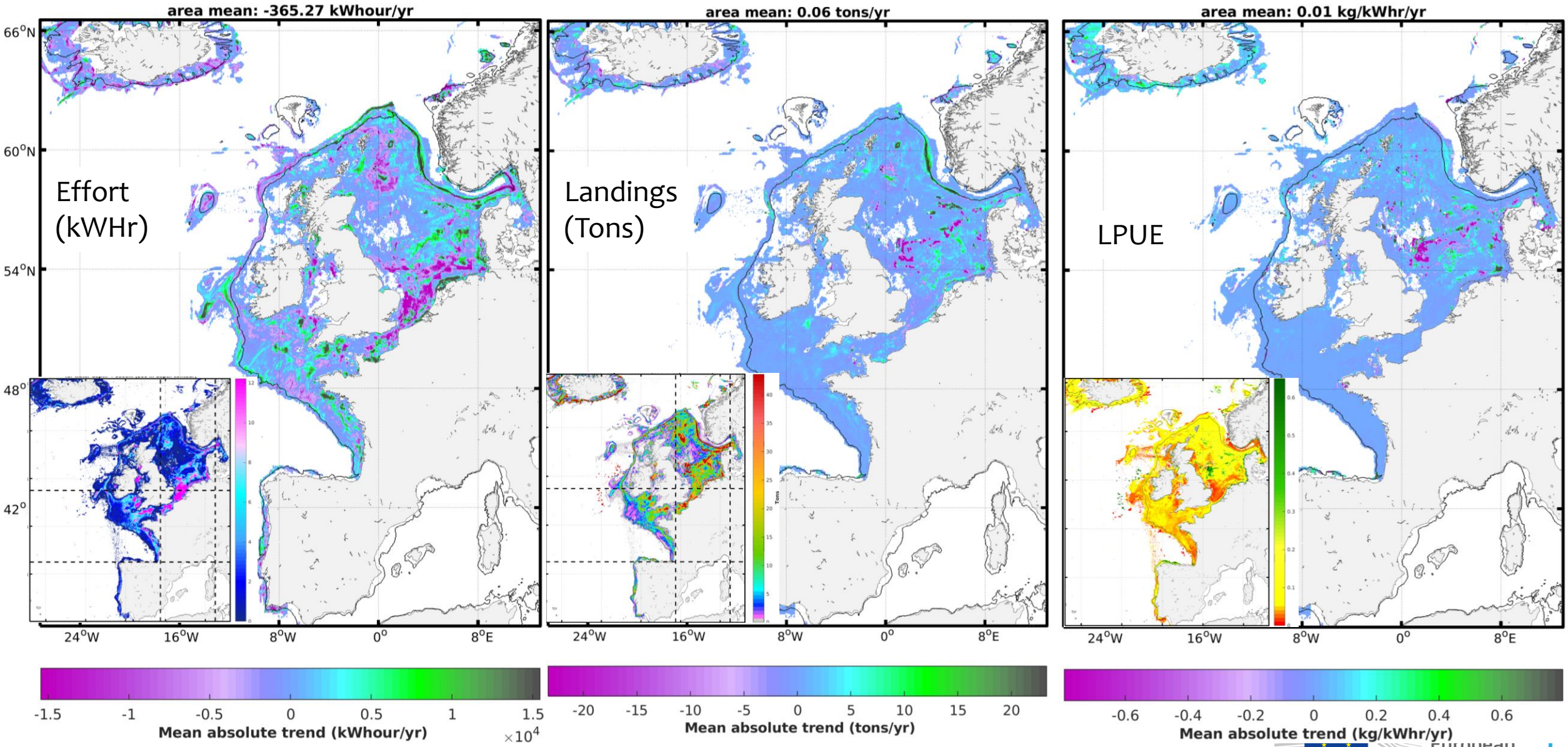
TREND MAPS

ICES WGSFD (2009-2016, 0.05x0.05 deg.)

Mobile bottom gears

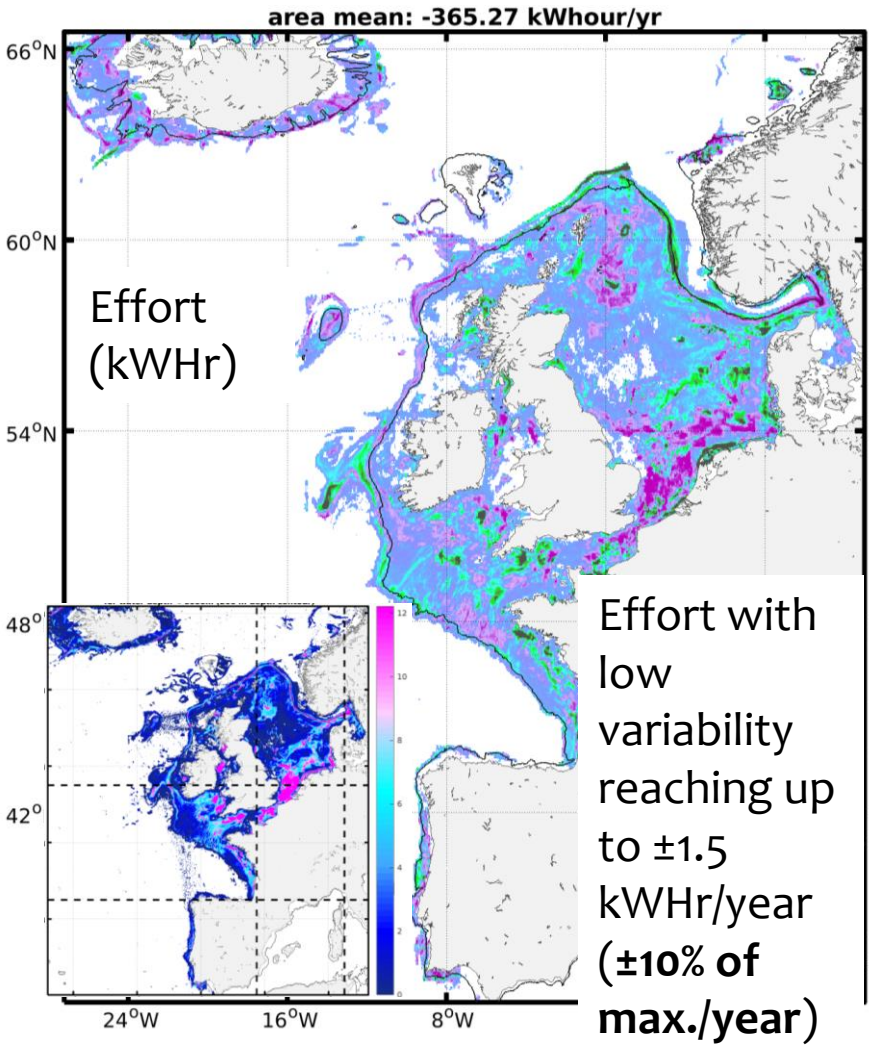


European Commission

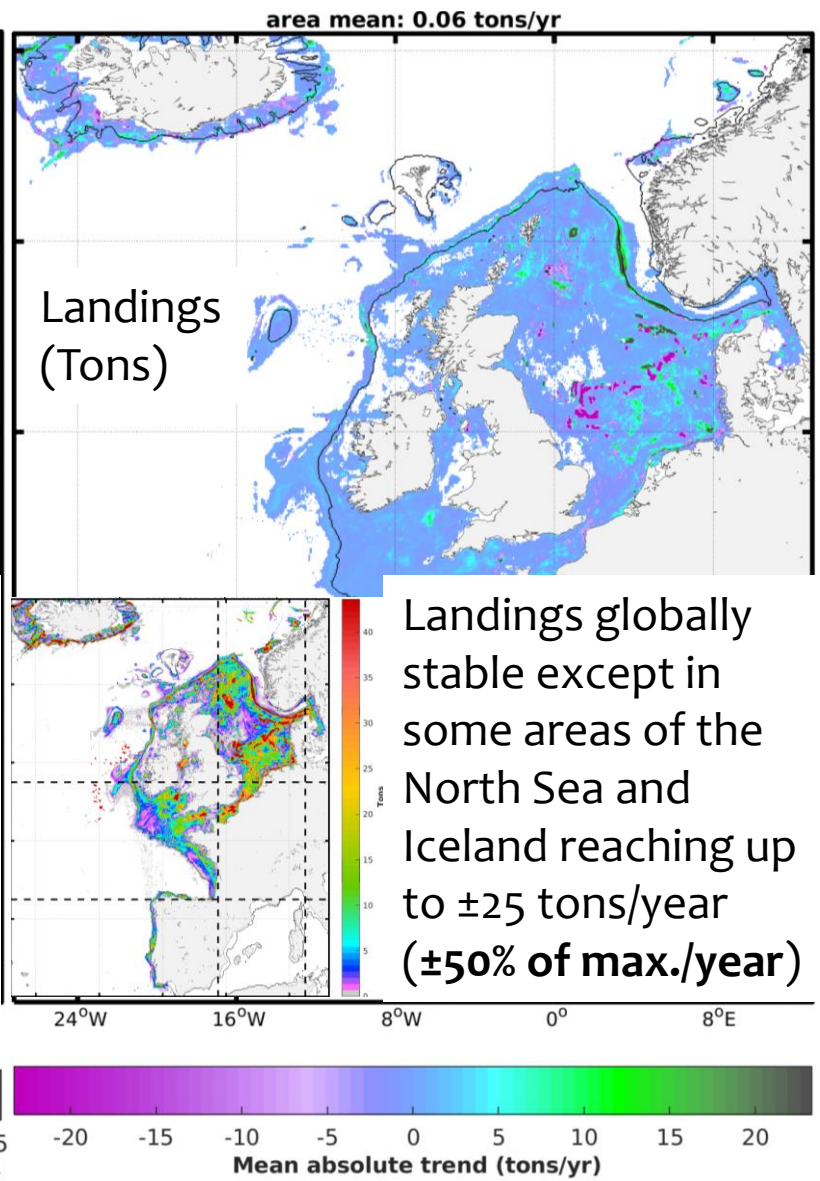
TREND MAPS

ICES WGSFD (2009-2016, 0.05x0.05 deg.)

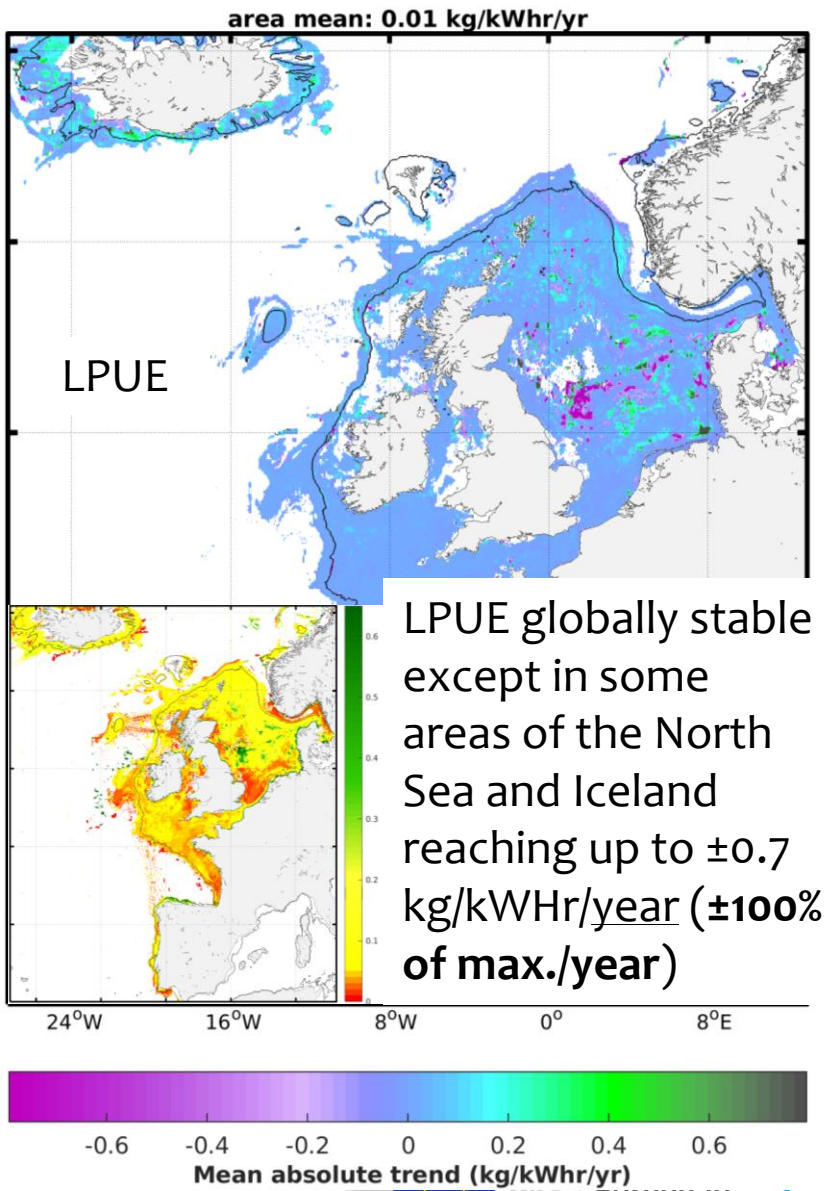
Mobile bottom gears



Effort with low variability reaching up to ±1.5 kWHr/year (**±10% of max./year**)



Landings globally stable except in some areas of the North Sea and Iceland reaching up to ±25 tons/year (**±50% of max./year**)



LPUE globally stable except in some areas of the North Sea and Iceland reaching up to ±0.7 kg/kWHr/year (**±100% of max./year**)

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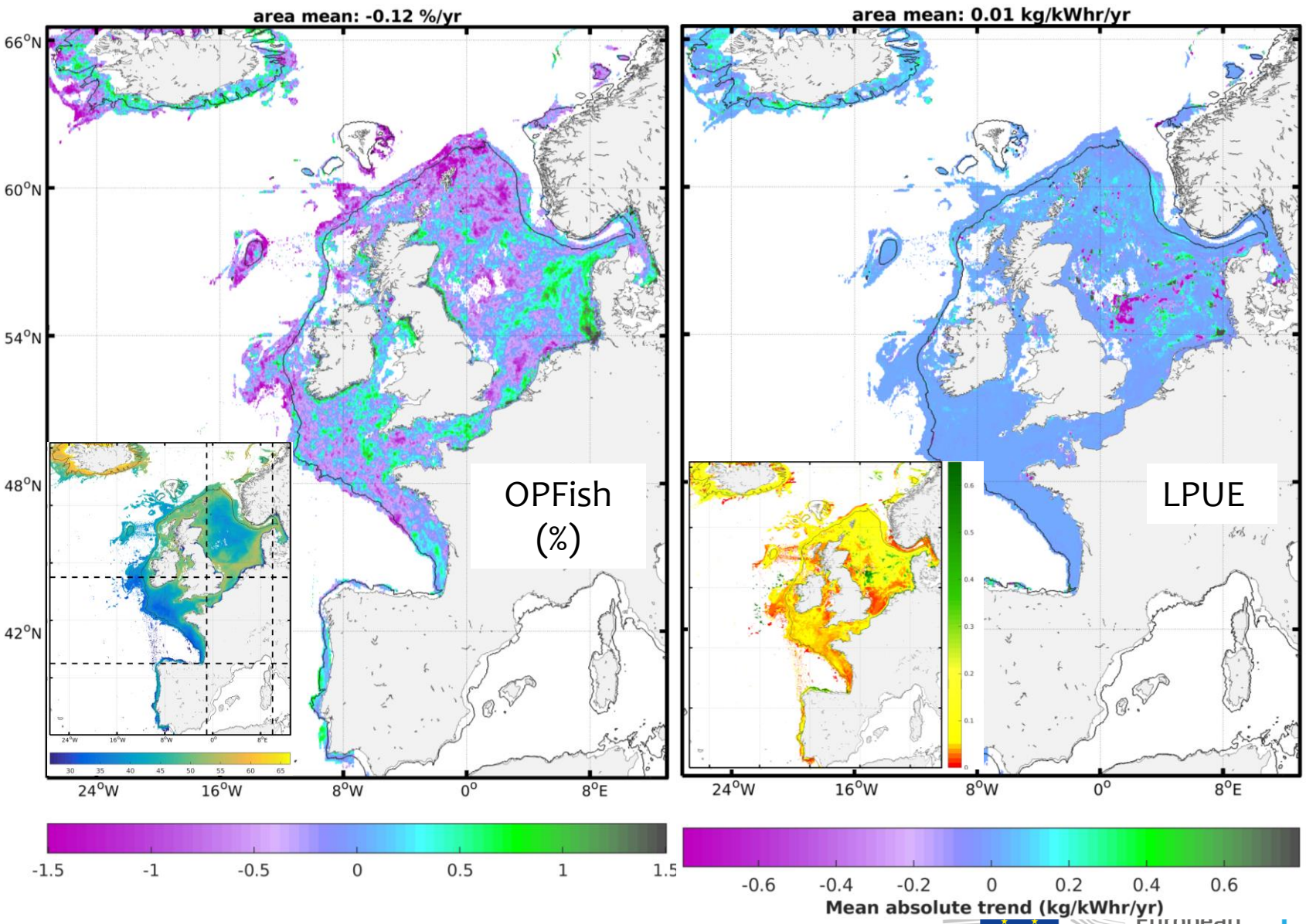
TREND MAPS

OPFish *vs* ICES WGSFD (2009-2016, 0.05x0.05 deg.)

Mobile bottom gears

- OPFish globally stable, ±1.5 absolute %/year (**±3 relative %/year**),
- LPUE globally stable except in some areas of the North Sea and Iceland reaching ±0.7 kg/kWHr/year (**±100%/year**).



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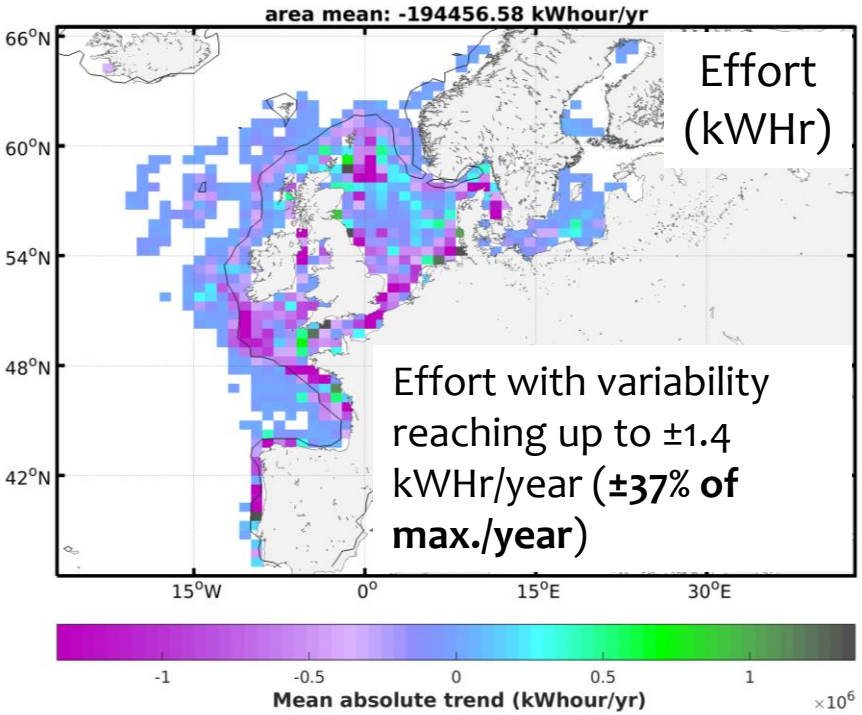
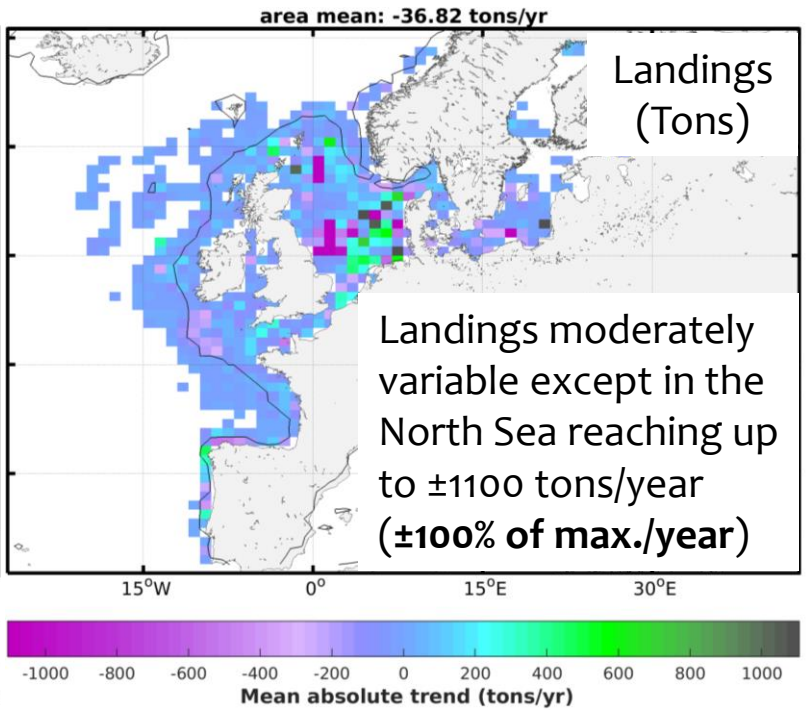
TREND MAPS

OPFish *vs* DCF ICES rectangles (2010-2016, 0.5x1 deg.)

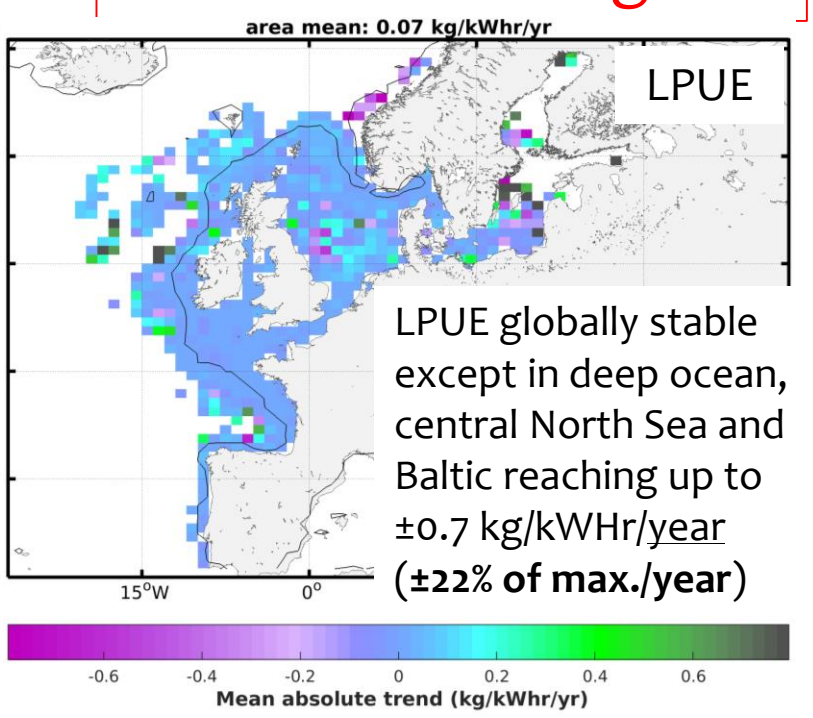
Mobile bottom gears



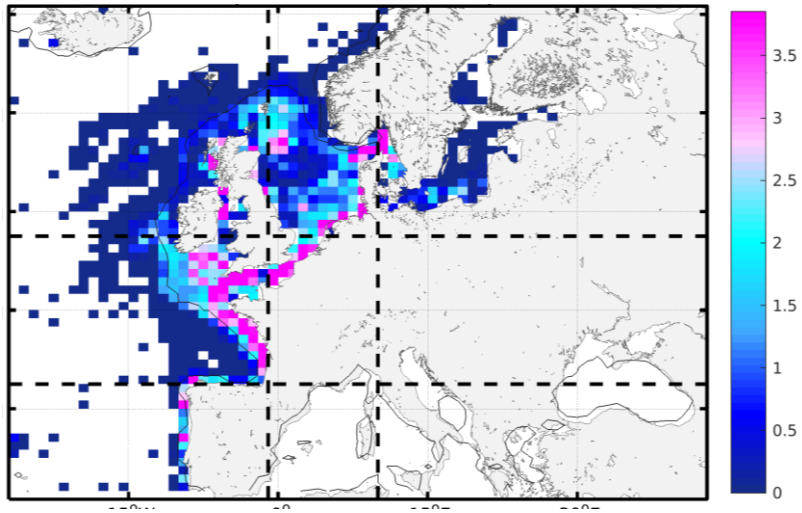
Effort with variability reaching up to ±1.4 kWHr/year (**±37% of max./year**)

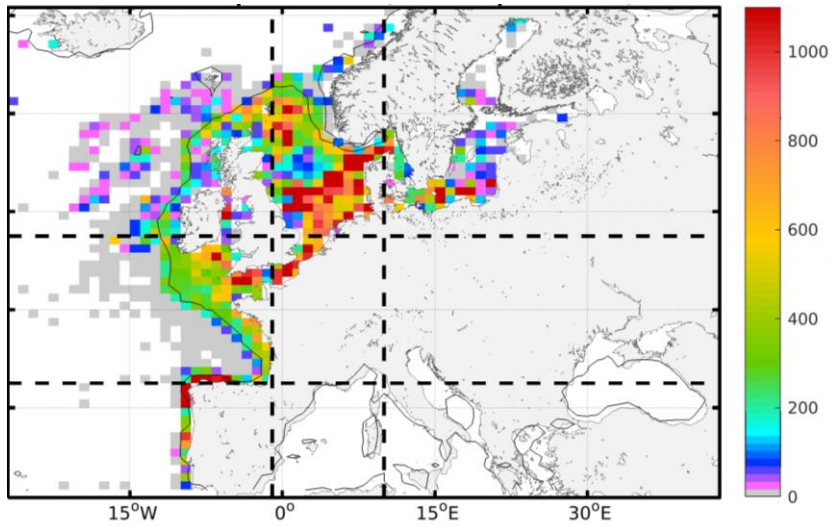


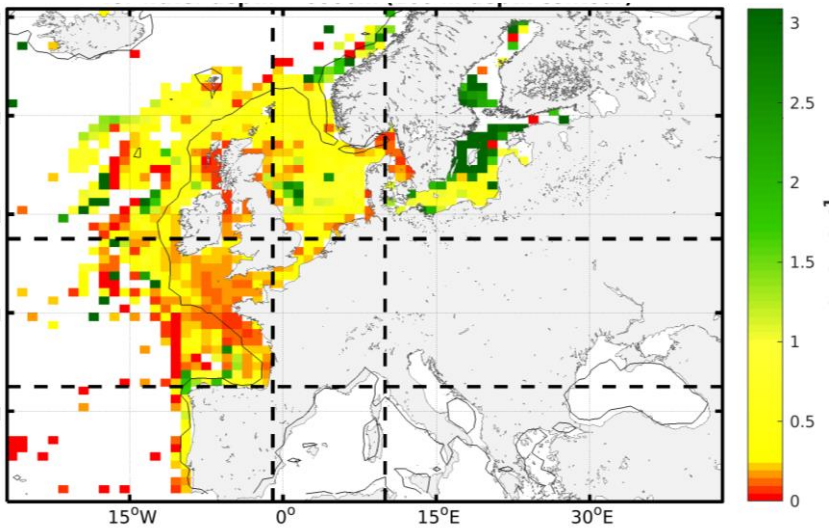
Landings moderately variable except in the North Sea reaching up to ±1100 tons/year (**±100% of max./year**)



LPUE globally stable except in deep ocean, central North Sea and Baltic reaching up to ±0.7 kg/kWHr/year (**±22% of max./year**)





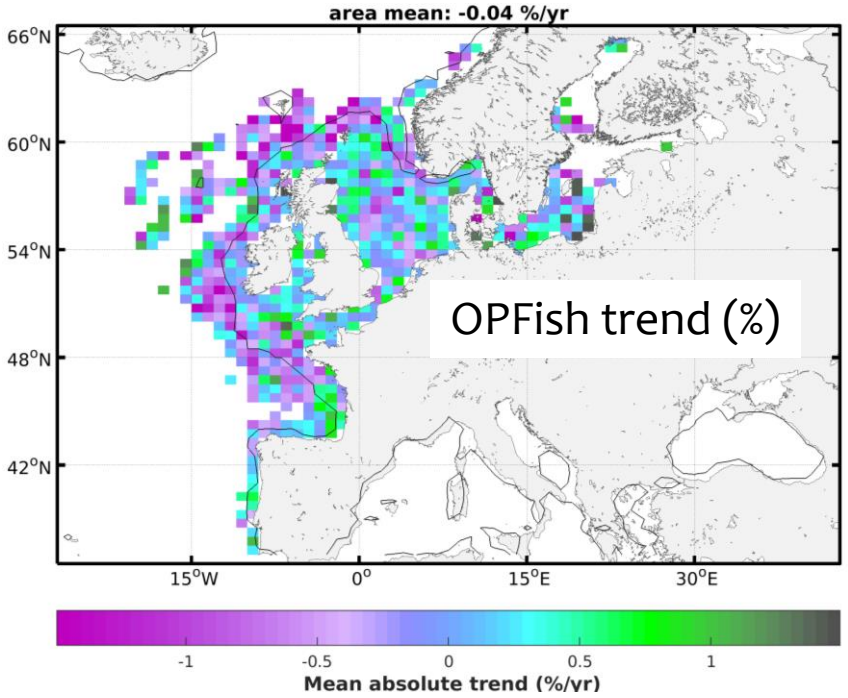


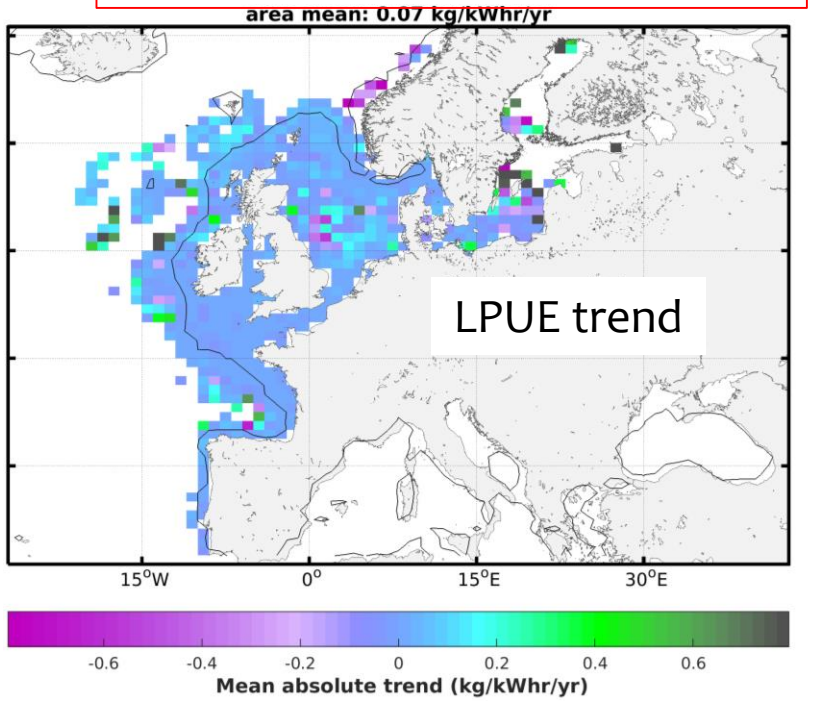
TREND MAPS

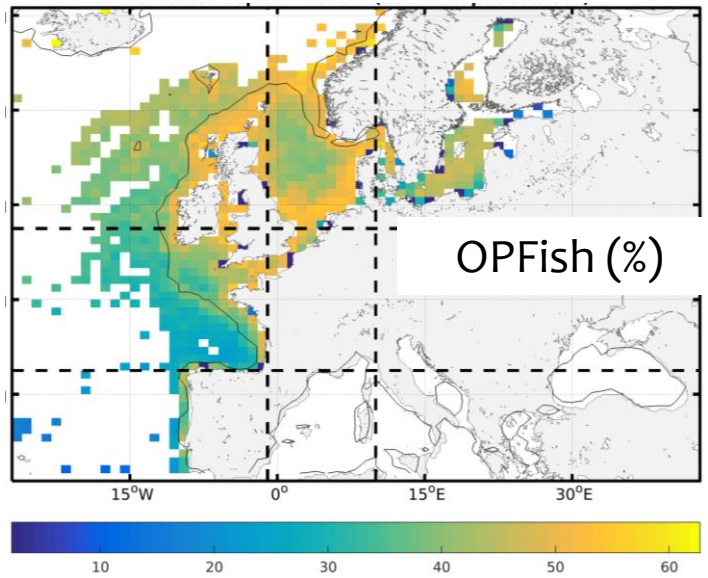
OPFish *vs* DCF ICES rectangles (2010-2016, 0.5x1 deg.)

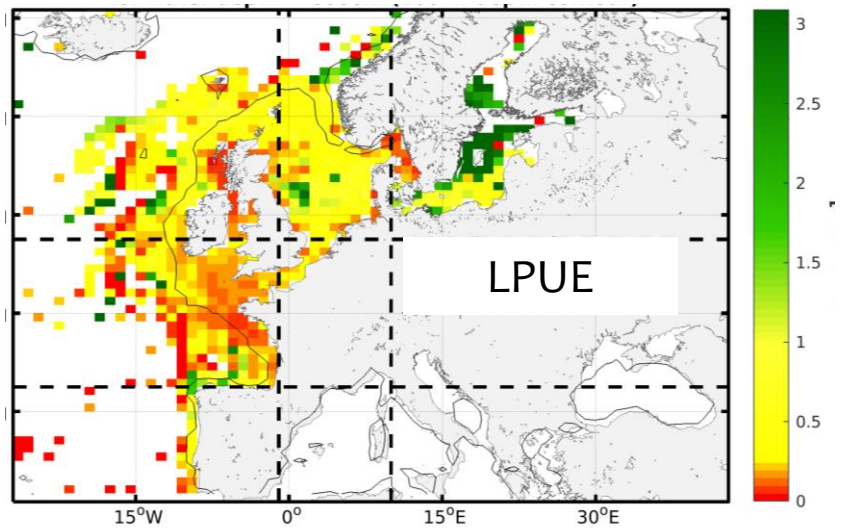
Mobile bottom gears

- OPFish globally stable, ±1.5%/year (**±3%/year**),
- LPUE globally stable except in deep ocean, central North Sea and Baltic reaching up to ±0.7 kg/kWHr/year (**±22% of max./year**)



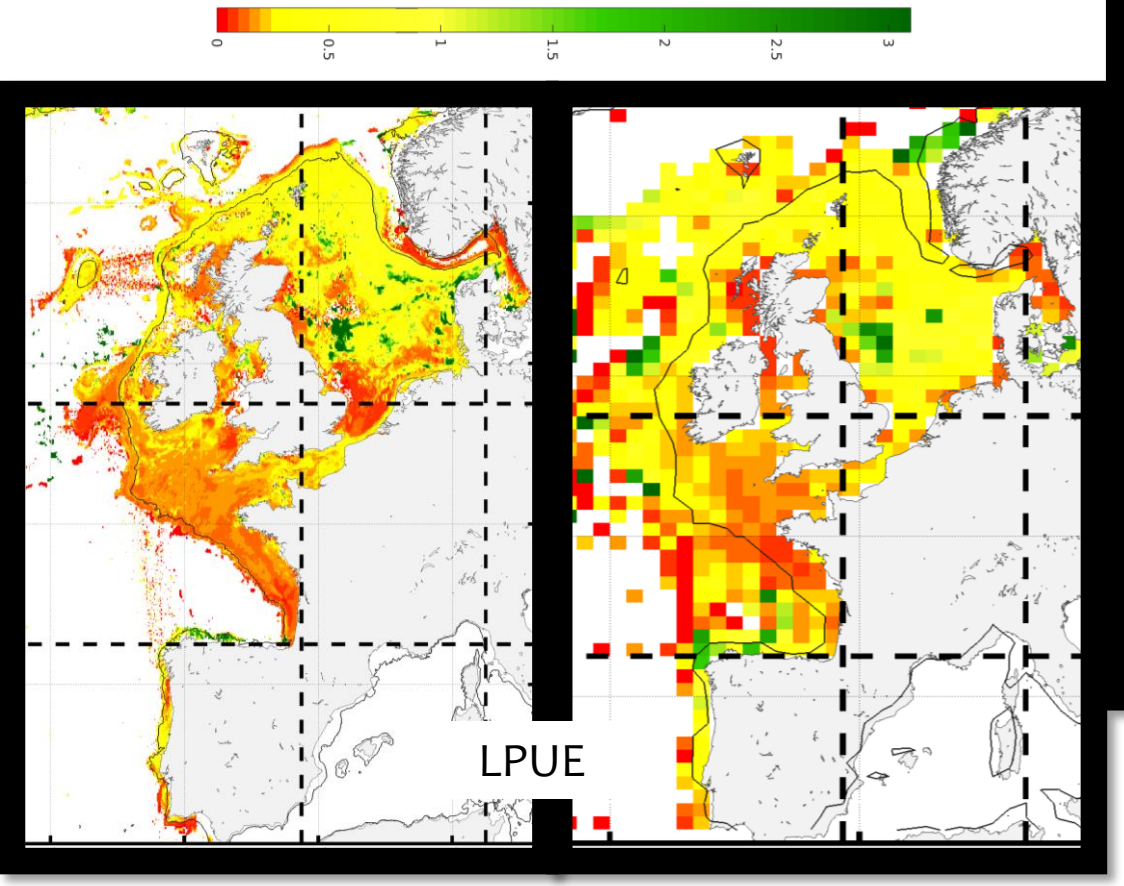


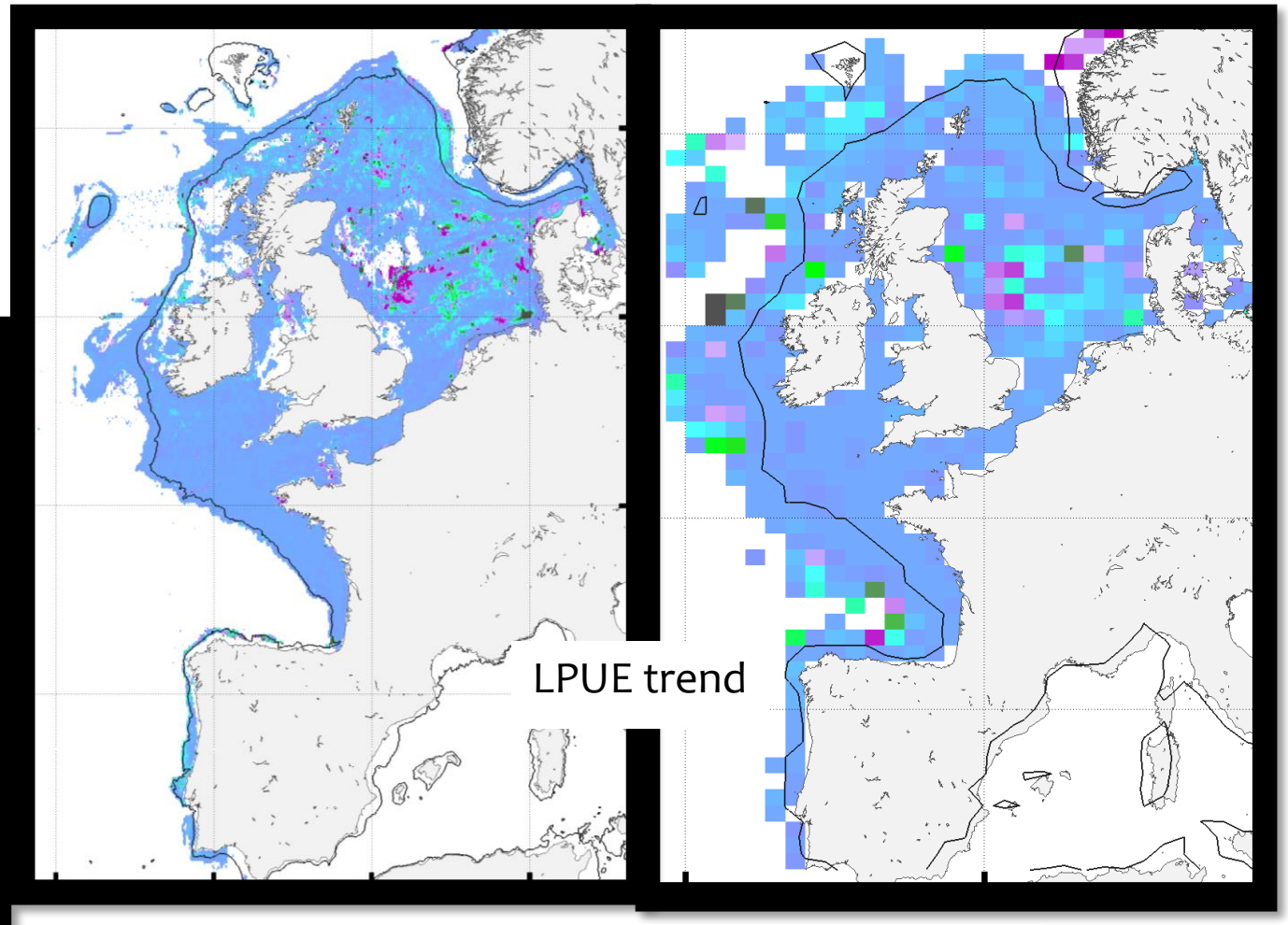


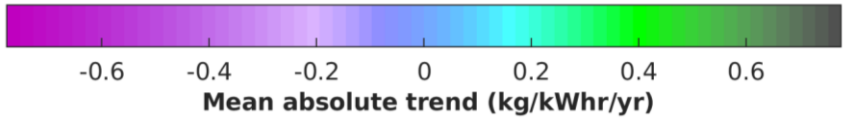


0.05x0.05 deg. *vs* 0.5x1 deg. (2010-2016)

Mobile bottom gears







Mean LPUE:

- General consistency except in the southern North Sea,
- strong variability at fine scale.

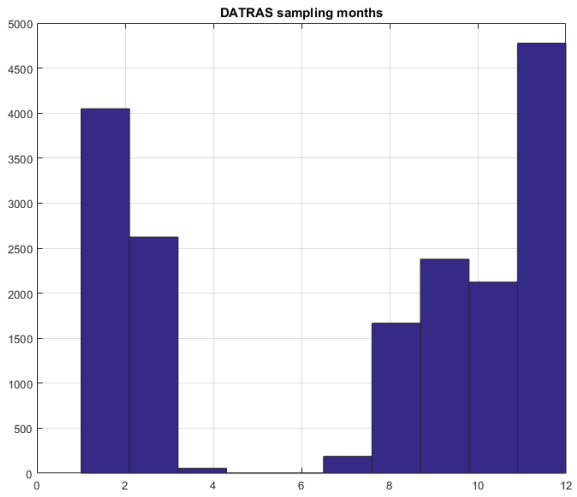
LPUE trend:

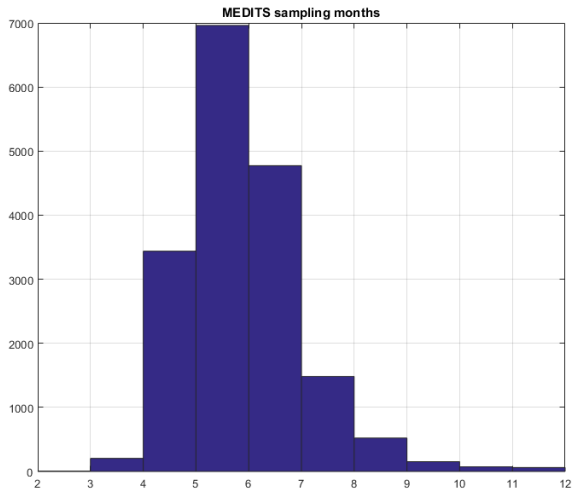
- General consistency,
- Fine scale changes occur in the northern and central North Sea.

European Commission

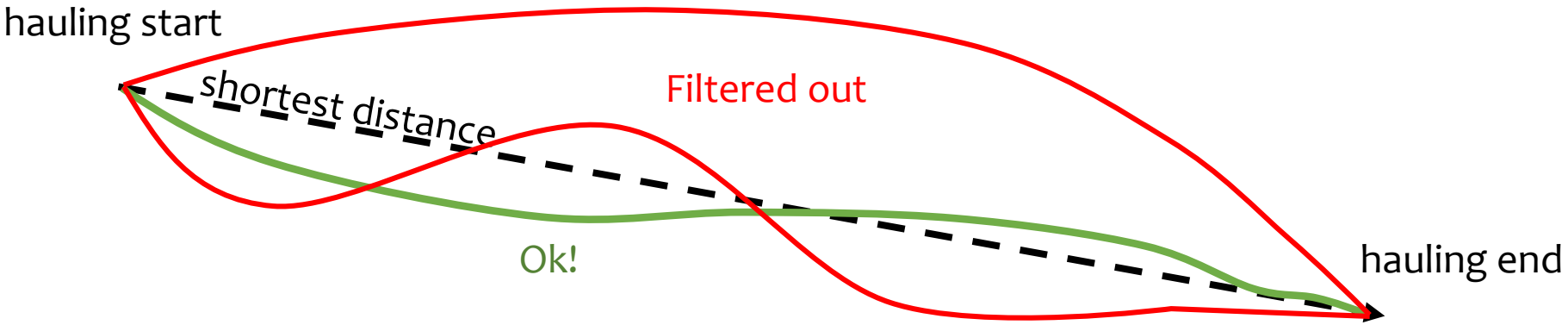
Scientific Surveys DATRAS-MEDITS

Different sampling period: impact?



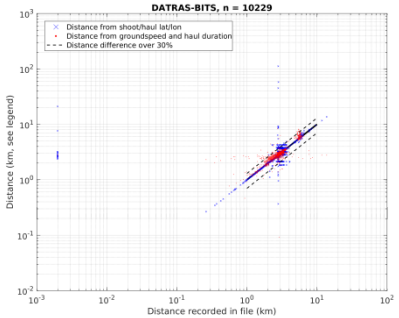


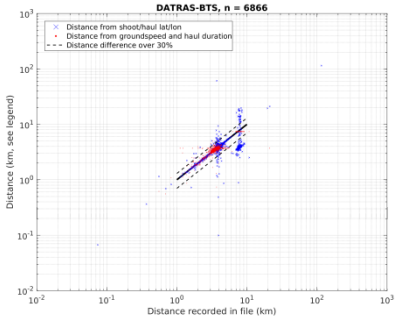
Filtering of hauls for which the stored hauling distance is **> 30%** of the shortest distance between hauling start and end
-> For limiting catchability bias in an excessive curving trajectory.

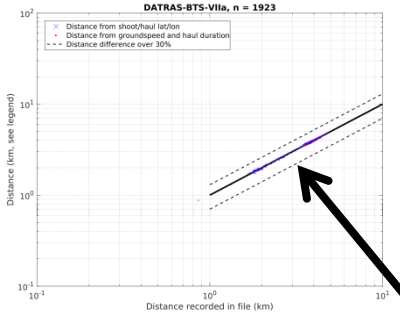


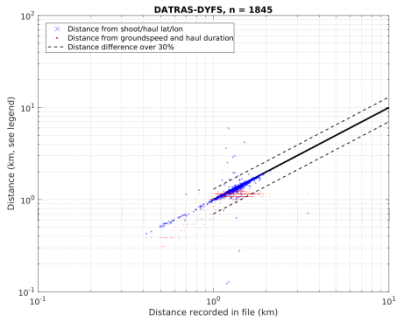
Scientific Surveys DATRAS-MEDITS

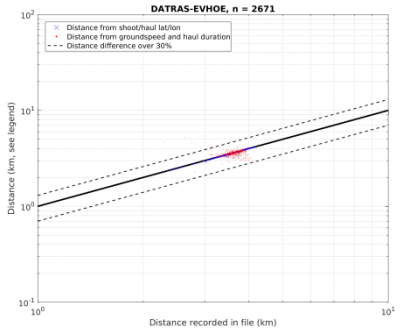
Haul filtering from excessive curving DATRAS vs MEDITS

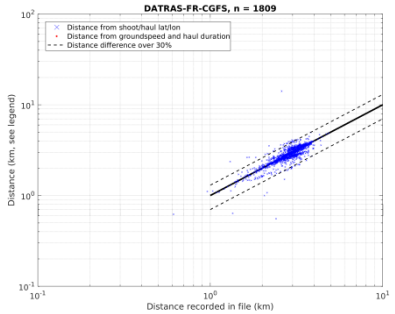


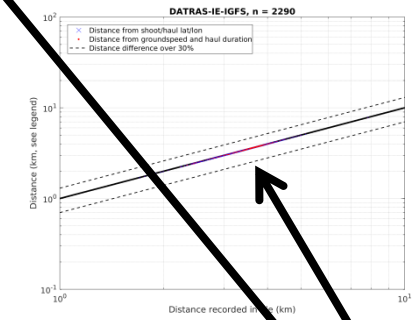


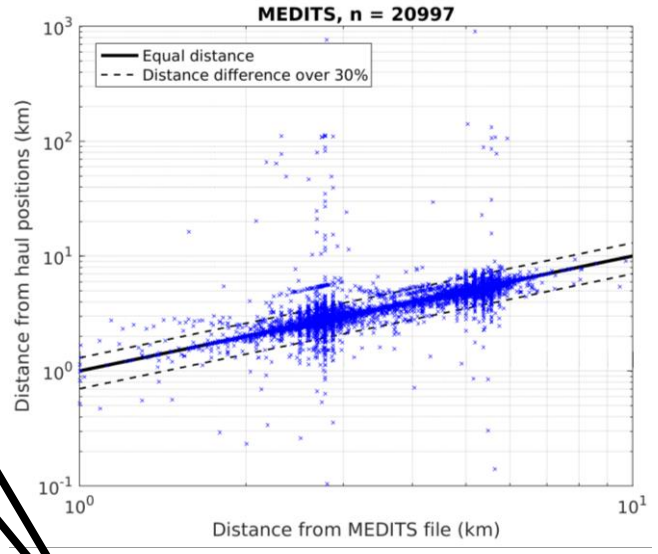


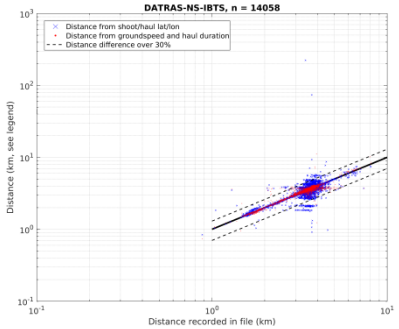


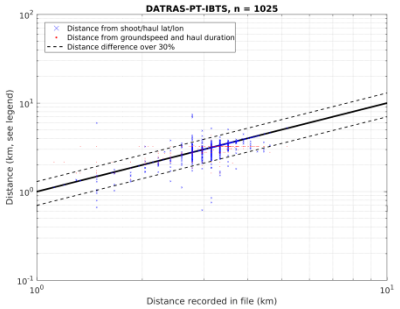


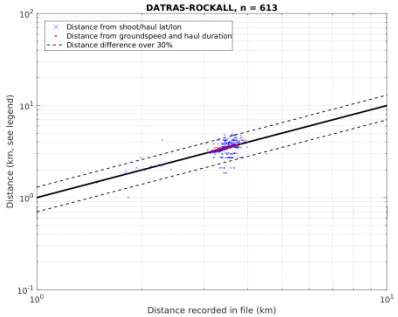


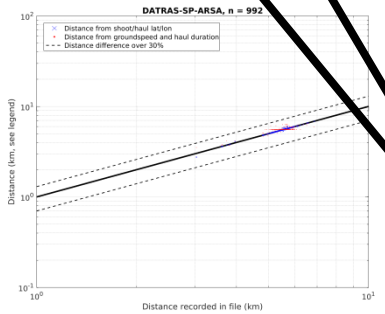


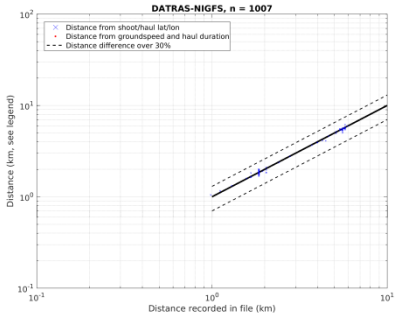


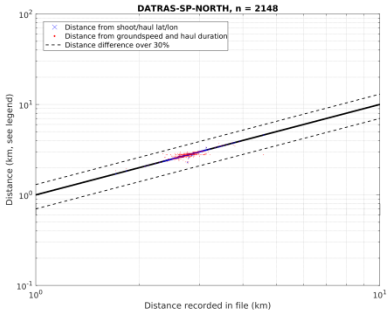


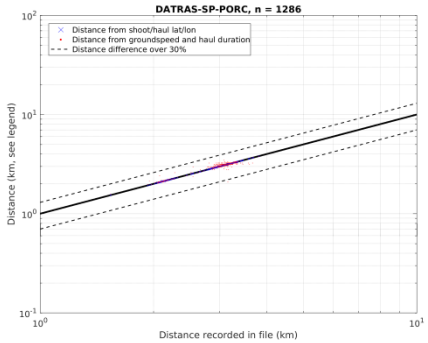


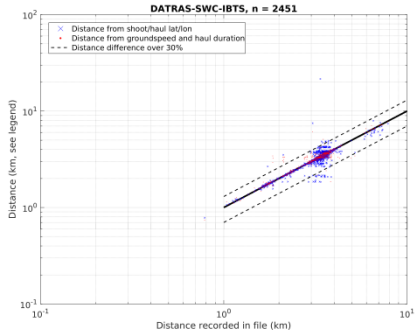












Are some DATRAS areas storing shortest distance? Likely…

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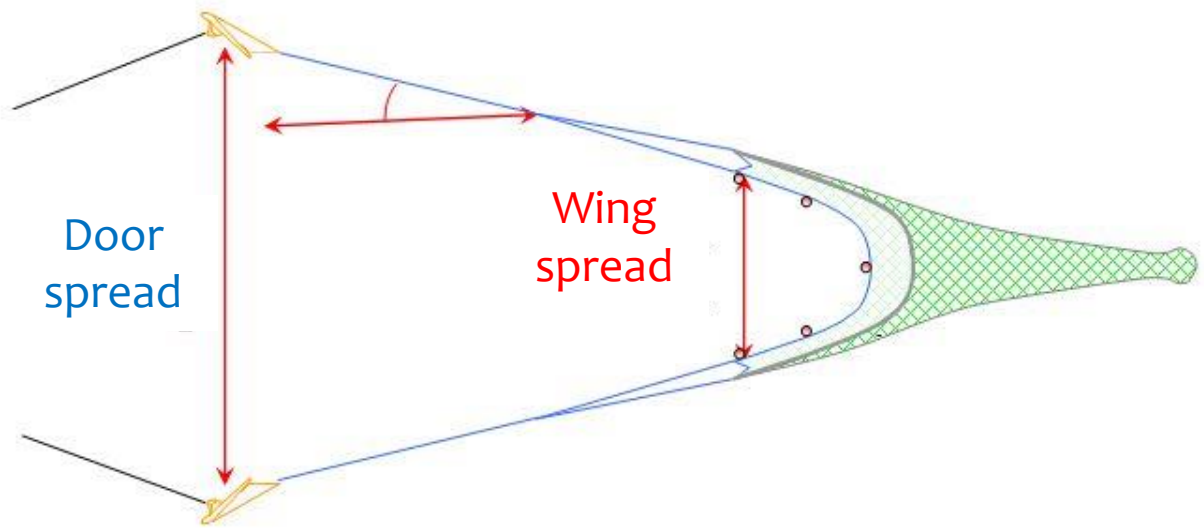
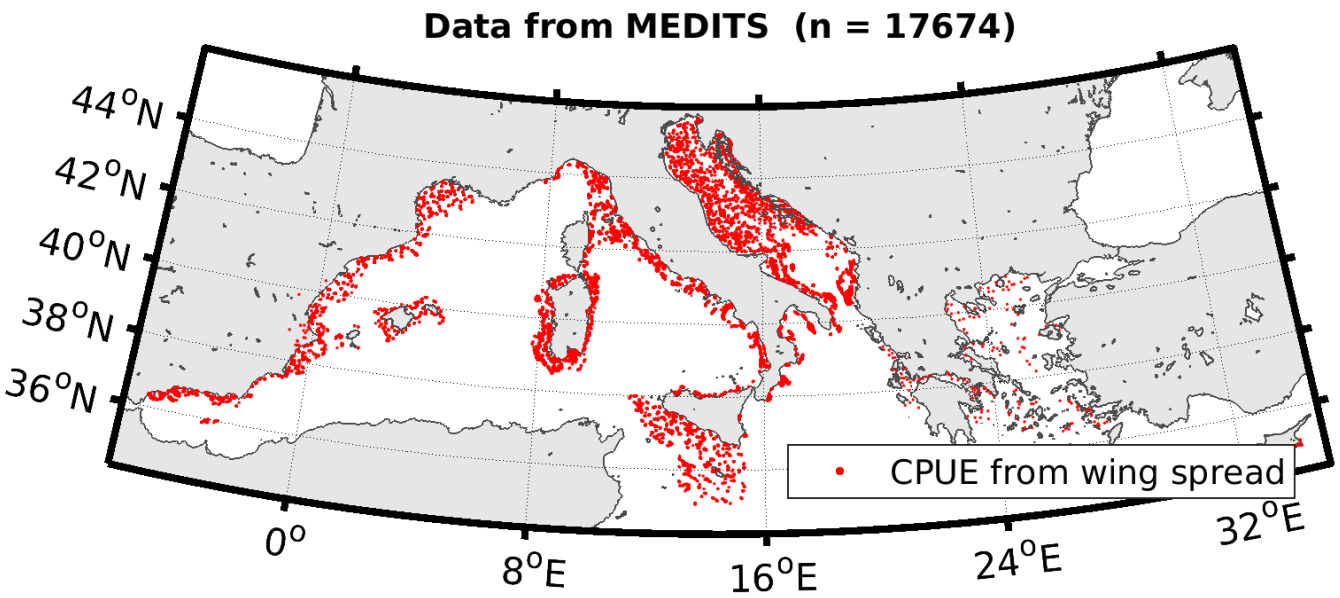
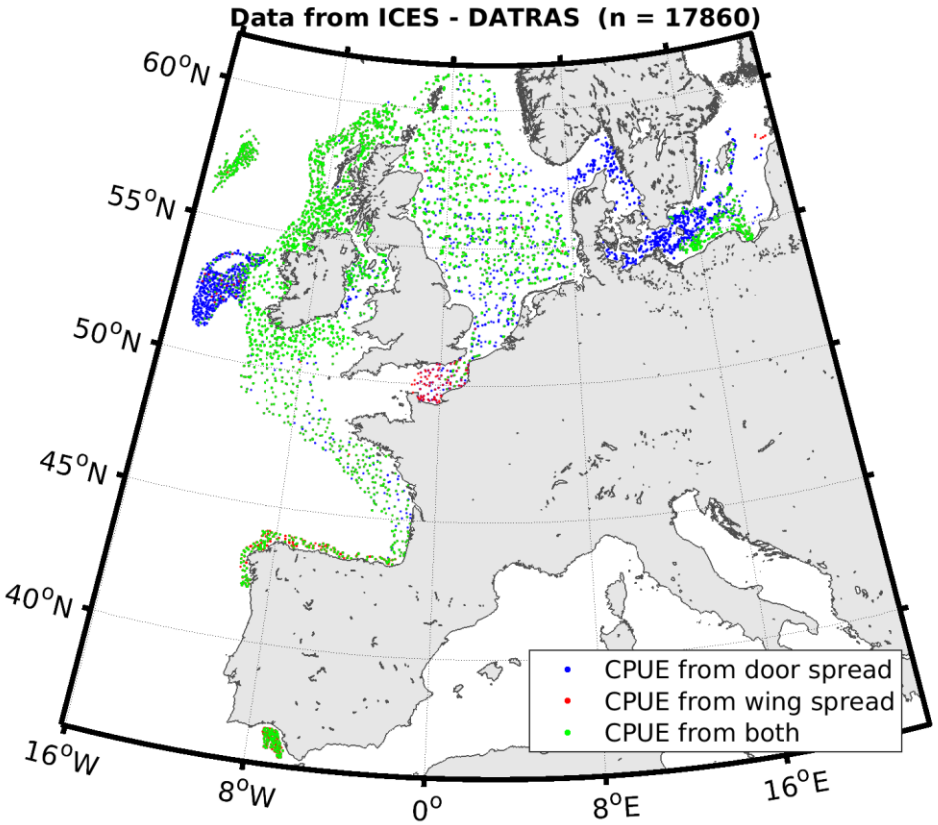
Scientific Surveys DATRAS-MEDITS

Wing vs door spread?
(only wing spread available for MEDITS)







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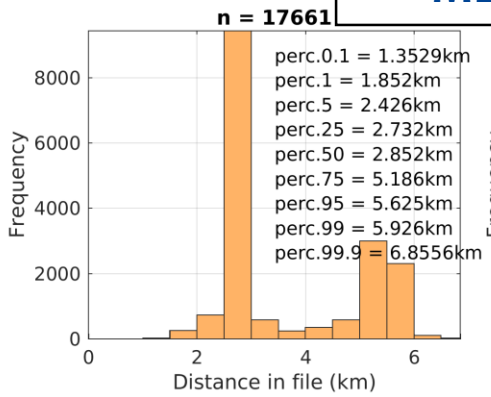
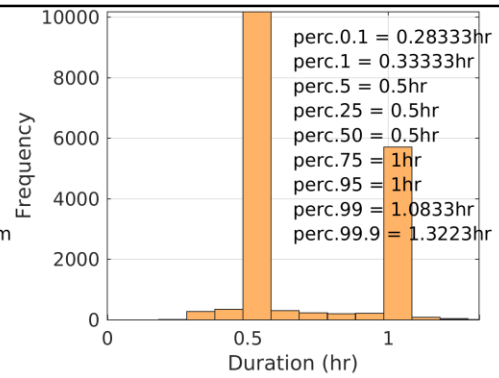
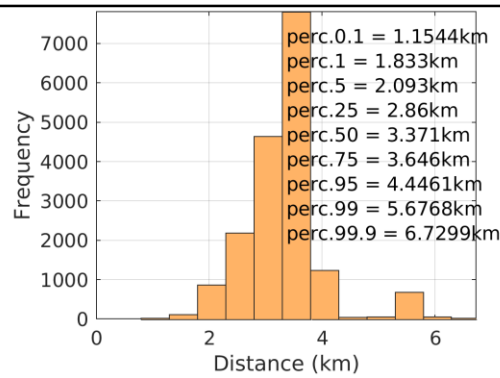
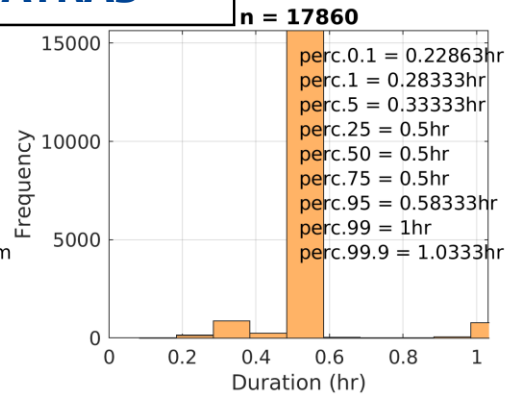
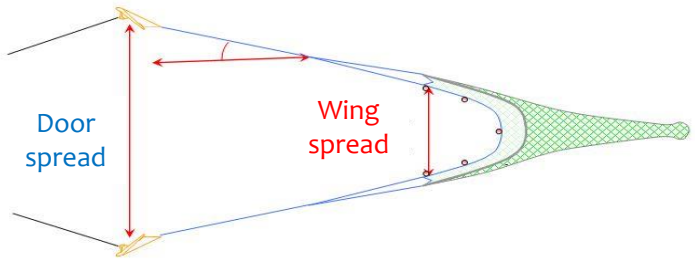
MEDITS vs DATRAS

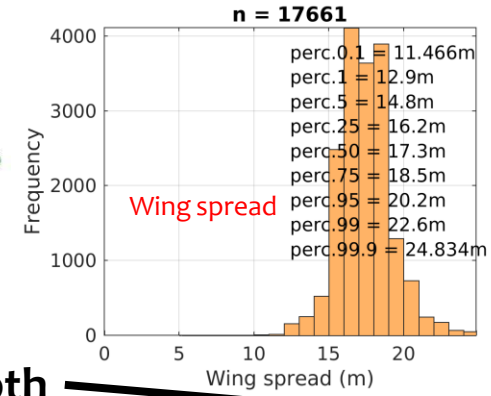


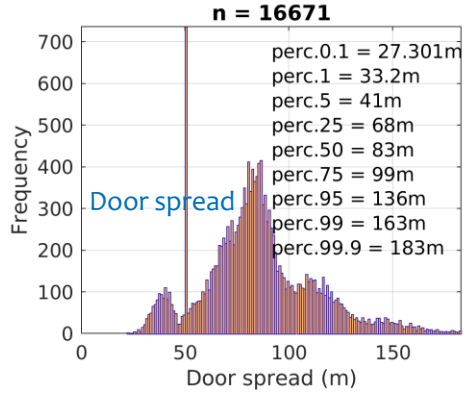


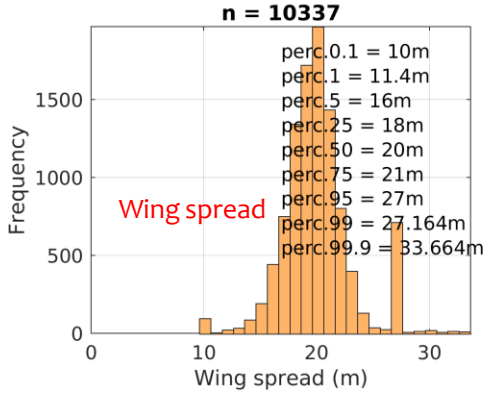






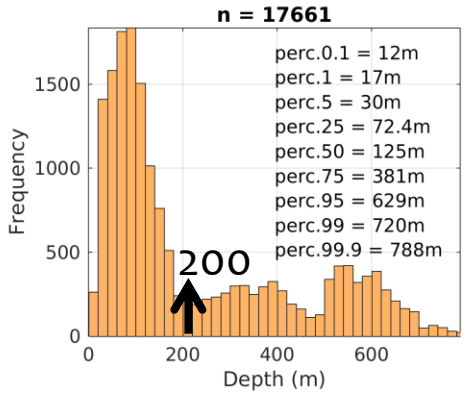


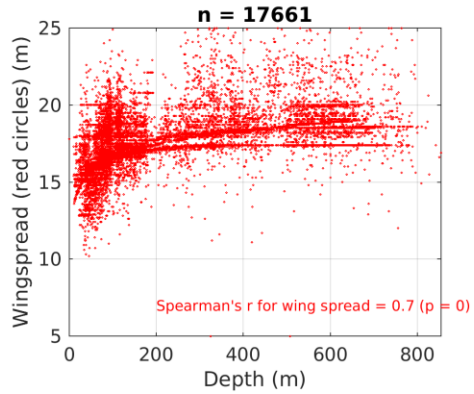


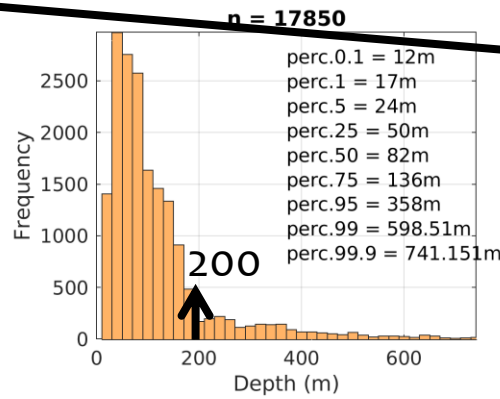


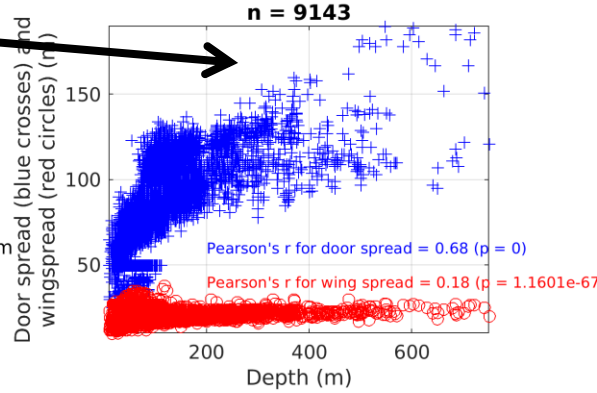
Wing vs door spread?

- **Door spread highly variable with depth**



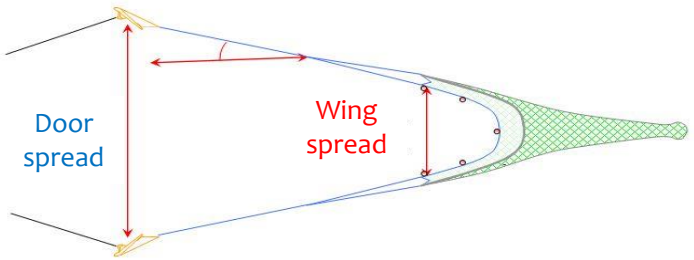




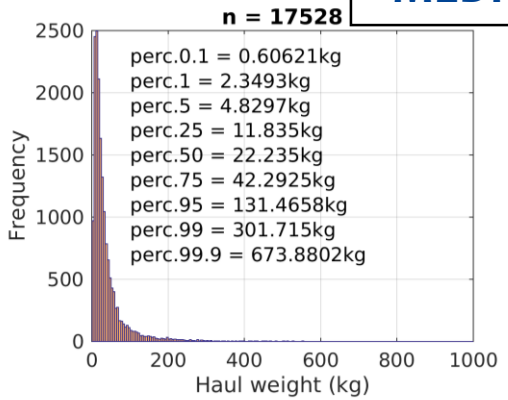


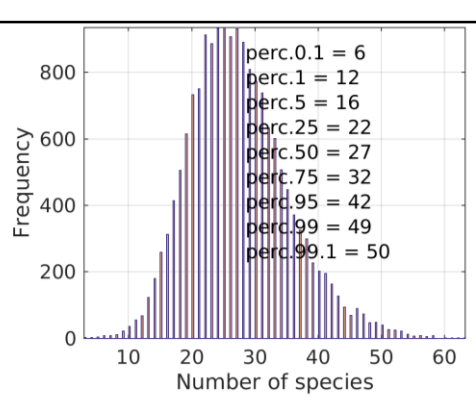
MEDITS (shelf+shelf break) vs (mostly shelf) DATRAS

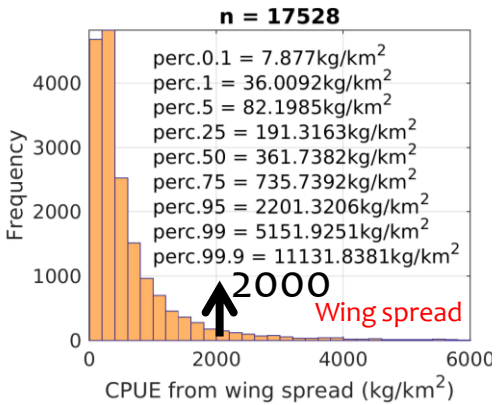
MEDITS = 1/10 * **DATRAS**

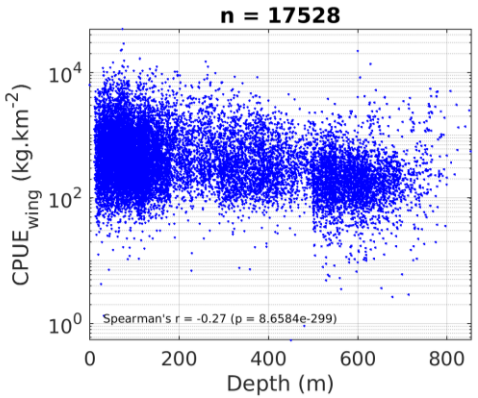


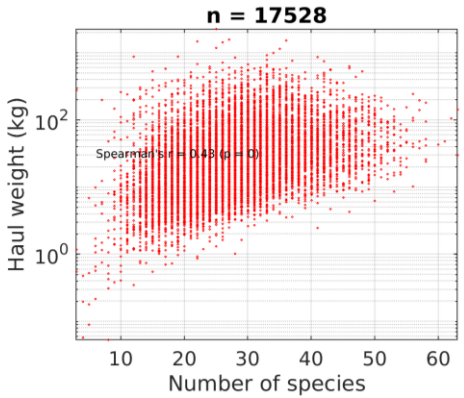
Wing vs door spread?

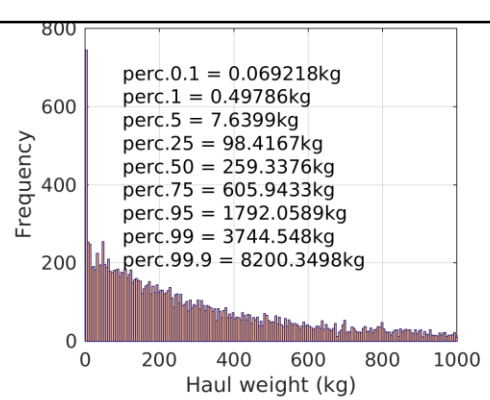


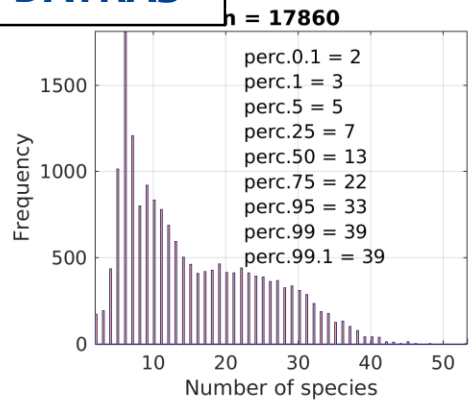


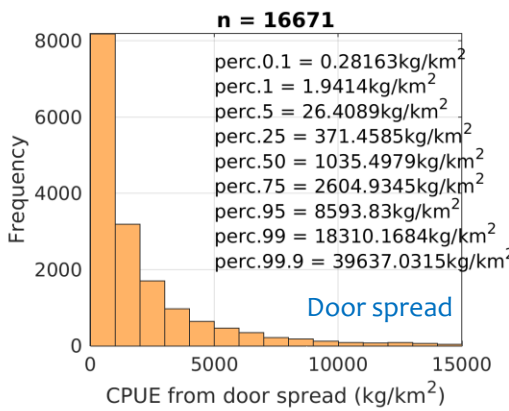


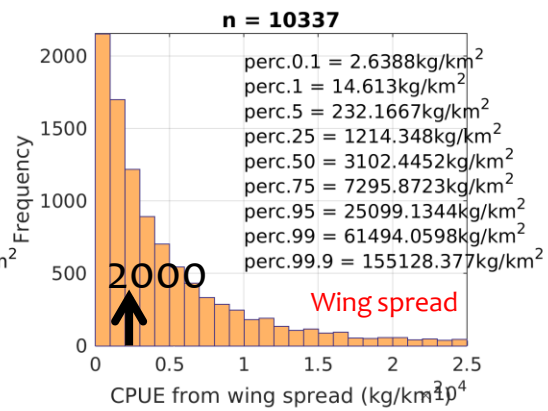


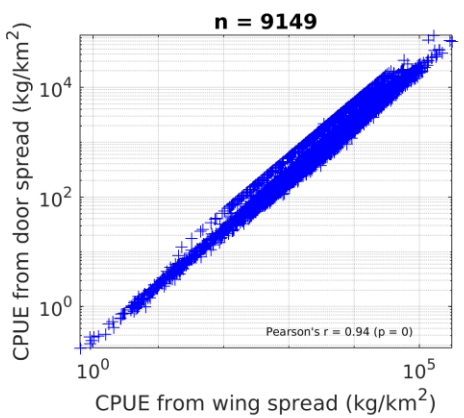


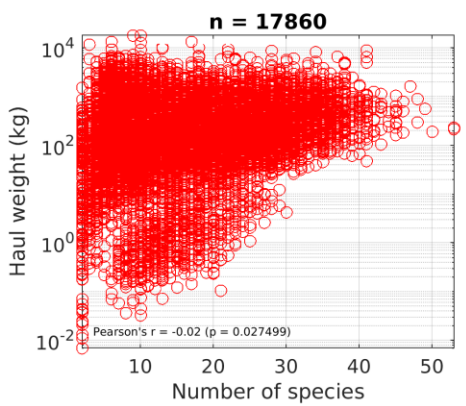






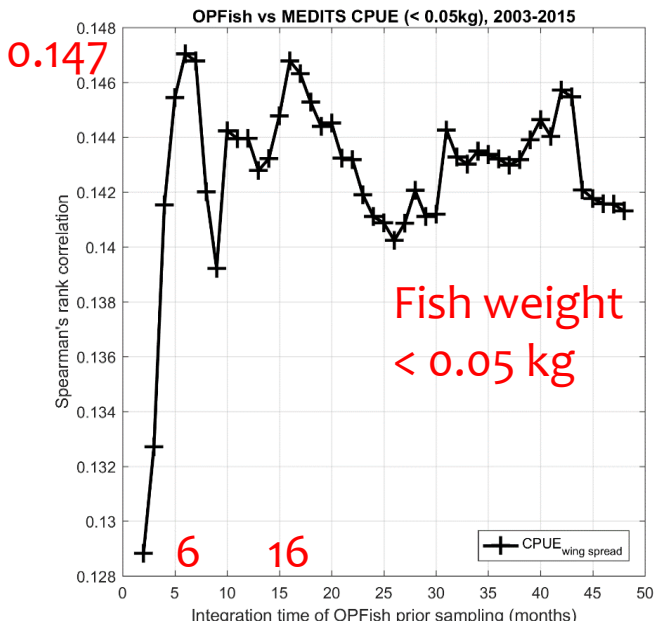


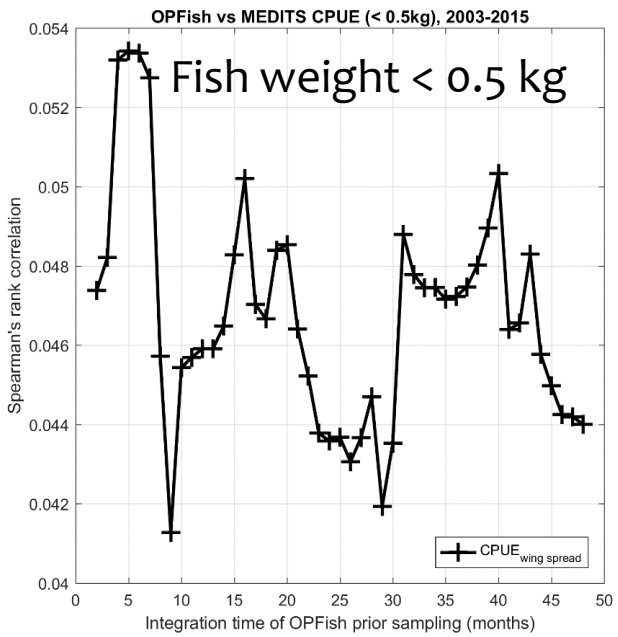


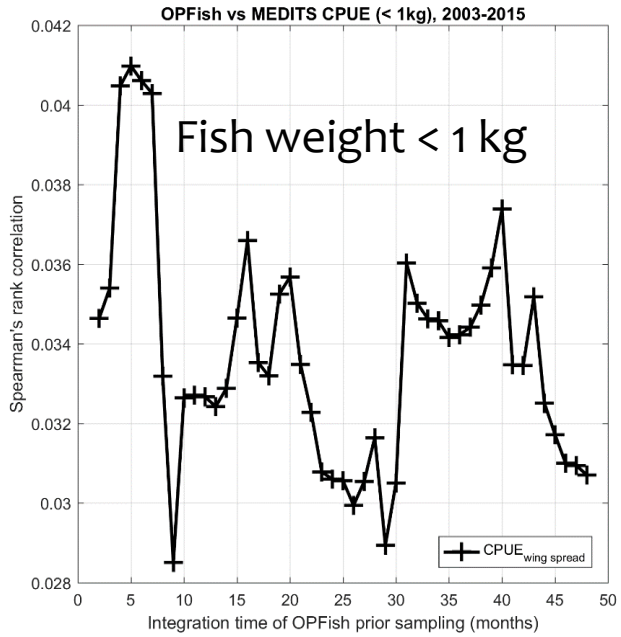


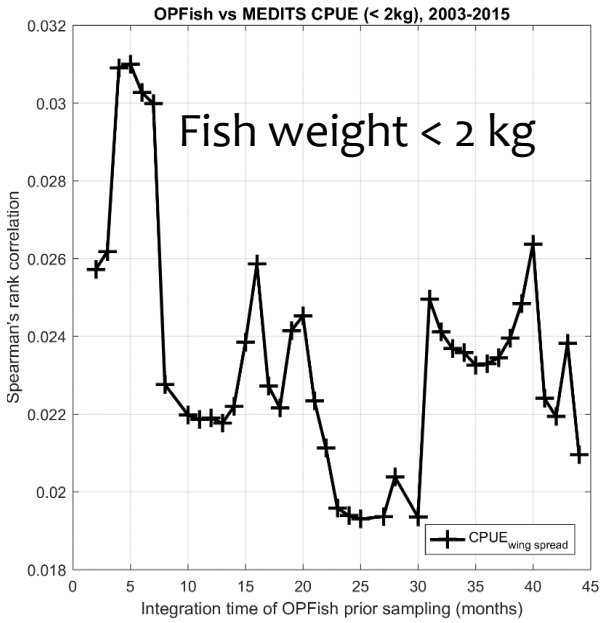
MEDITS **Higher *vs* lower biodiversity** **DATRAS**

MEDITS CPUE correlation with OPFish increasing integration time







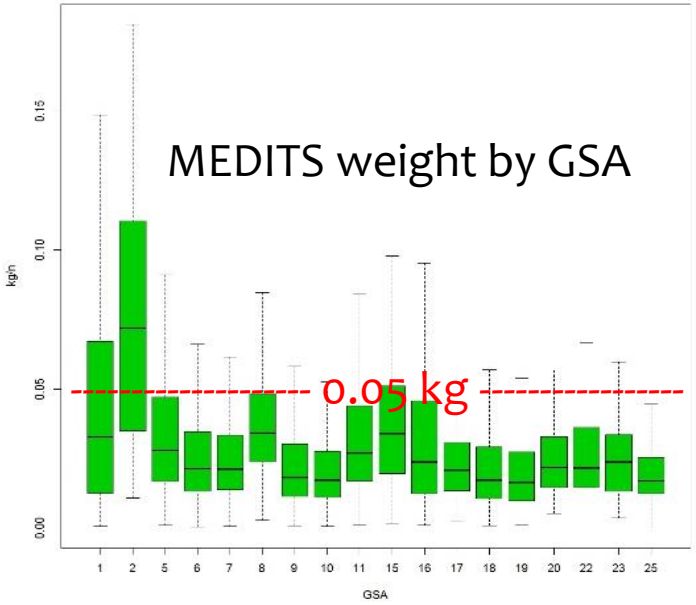


MEDITS

Highest correlation for:

- Fish weight < 0.05 kg
- OPFish integration time = 6 or 16 months
- 1 pixel of 0.042 deg. (3x3 pixels centered on haul leads to $\mathbf{r_s}$ = 0.136 for 16 months integration)

➢ 16 months more robust time integration (see also DATRAS): young fish+spawners



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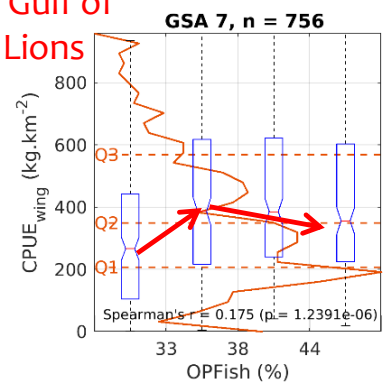
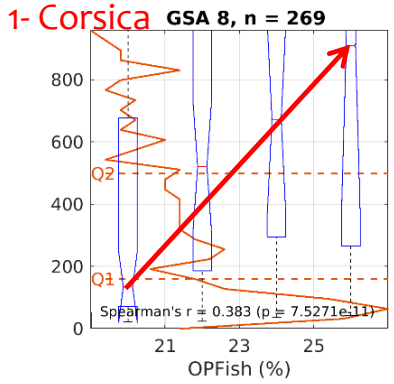
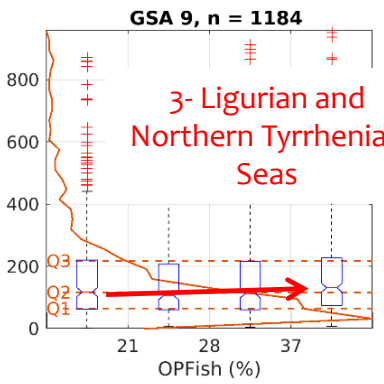
MEDITS CPUE fish weight < 0.05 kg correlation with OPFish 16 months by GSA

2- Gulf of Lions

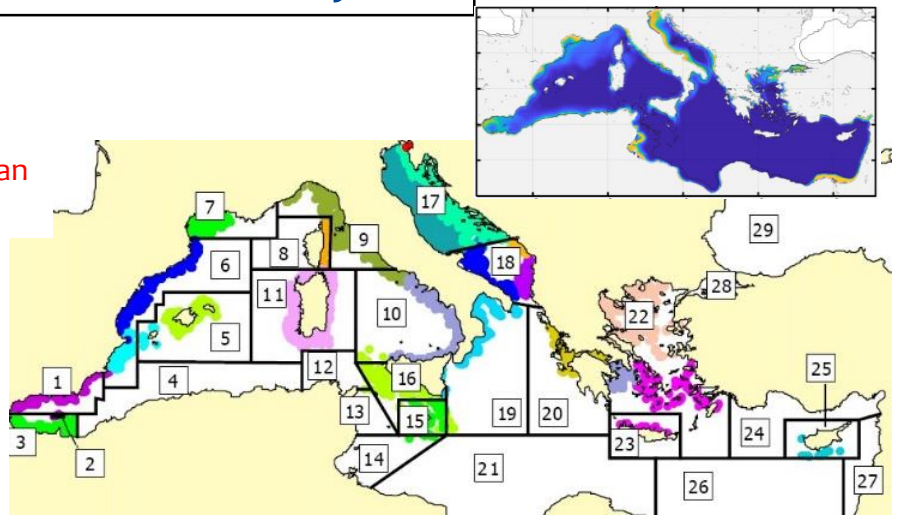


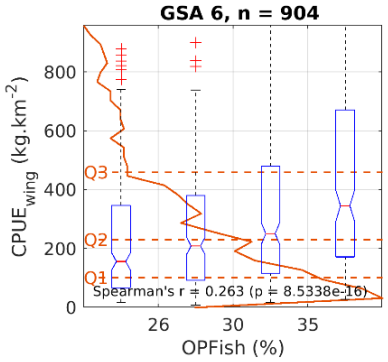
1- Corsica

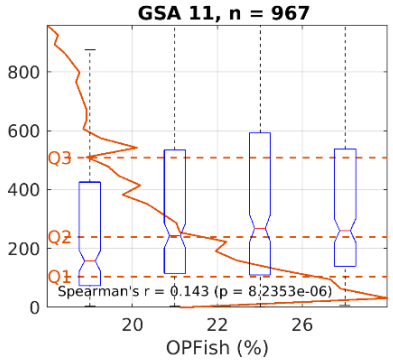


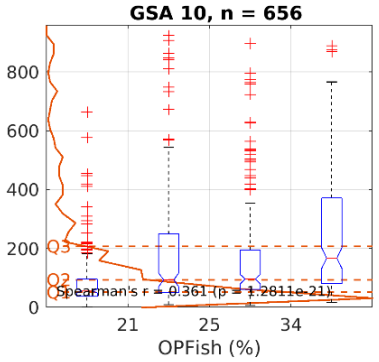


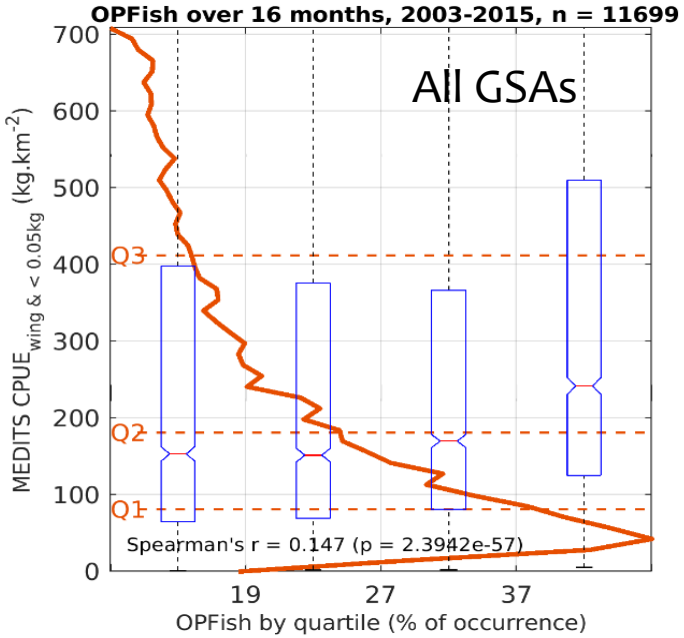
3- Ligurian and Northern Tyrrhenian Seas

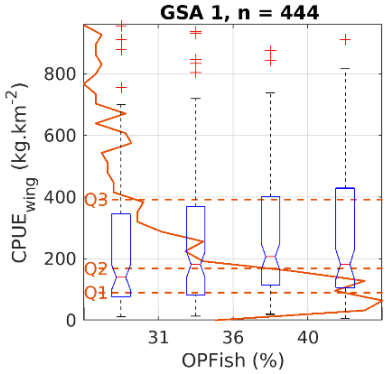




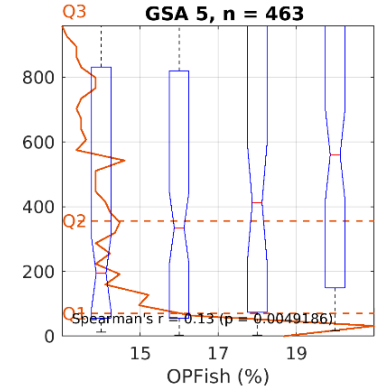








- Probable effect of excessive fishing effort on CPUE in diversely productive areas from 1 to 2 & 3.



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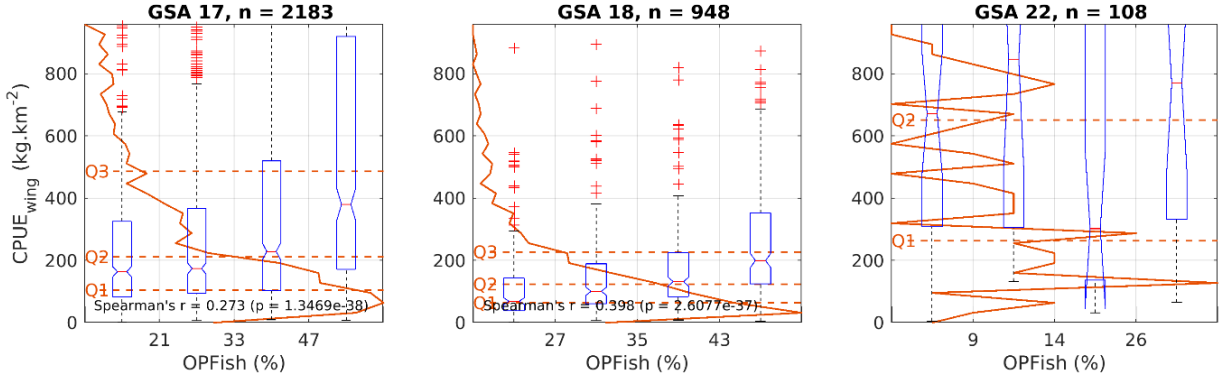
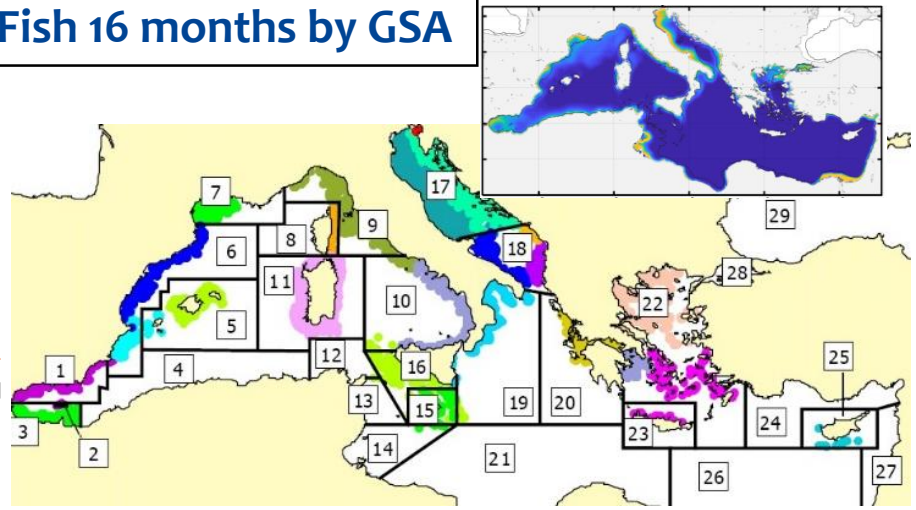
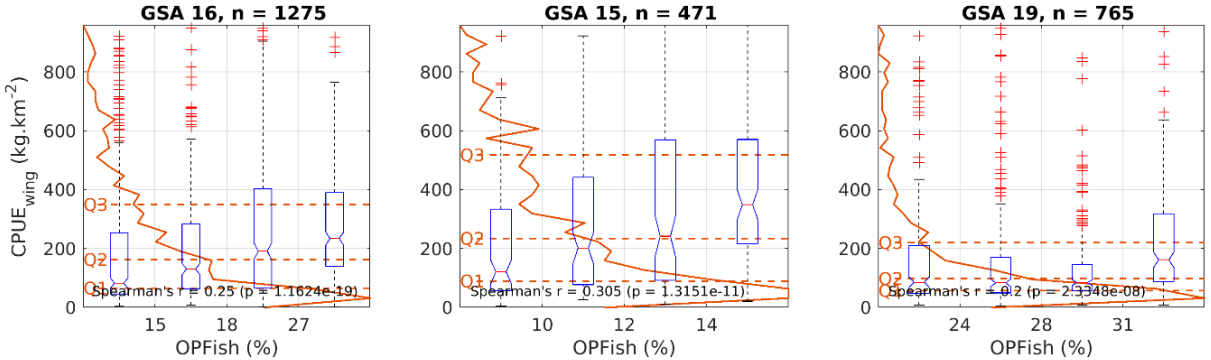
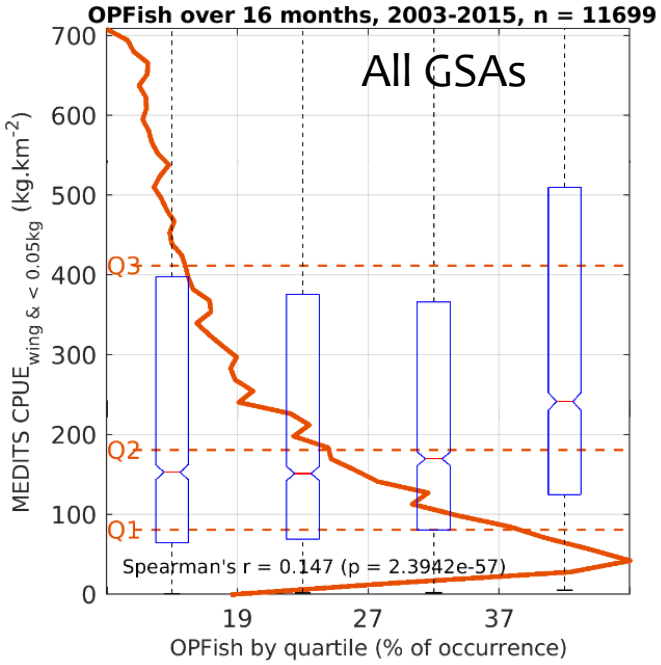
MEDITS CPUE fish weight < 0.05 kg correlation with OPFish 16 months by GSA



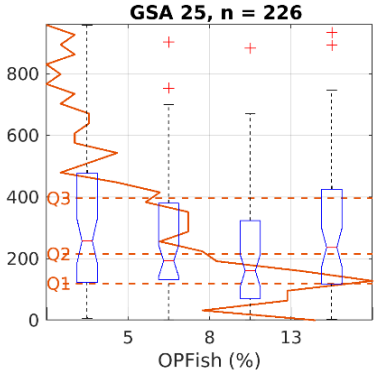






➢ The higher r_s, the lower fishing pressure compared to productivity?

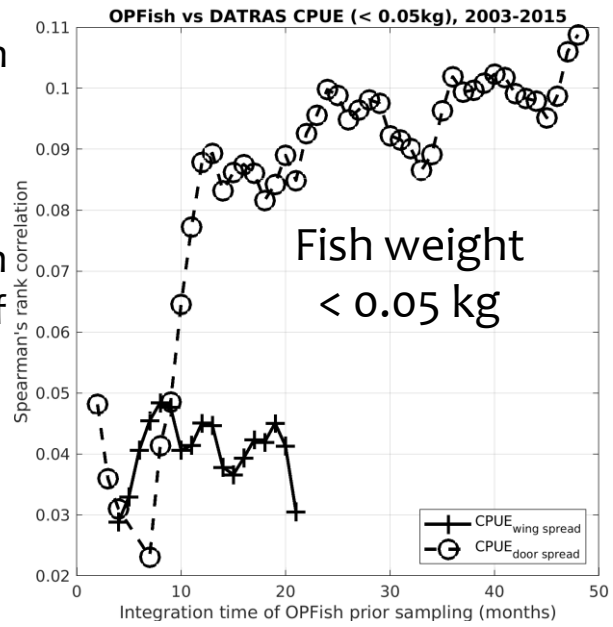
- r_s > 0.3 for GSA 8, 18, 10, 15
- On the opposite, no correlation for GSA 1, 9, 25, (excluding 22 – low # of hauls + complex geomorphology/currents and contrasted productivity levels)

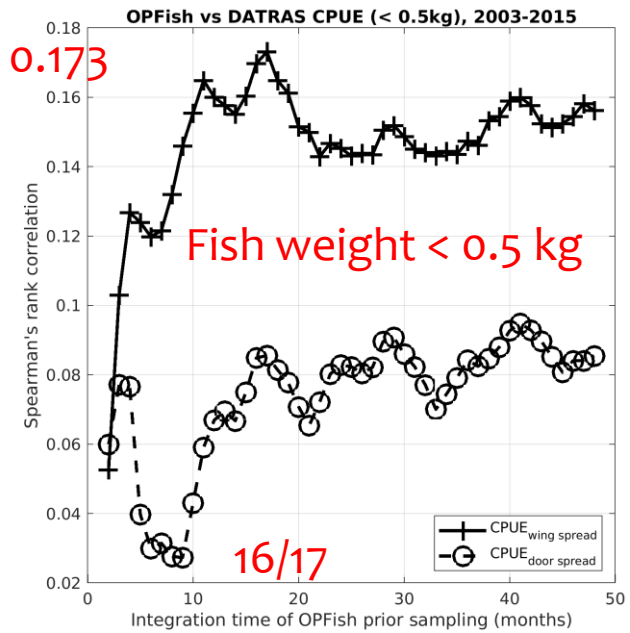


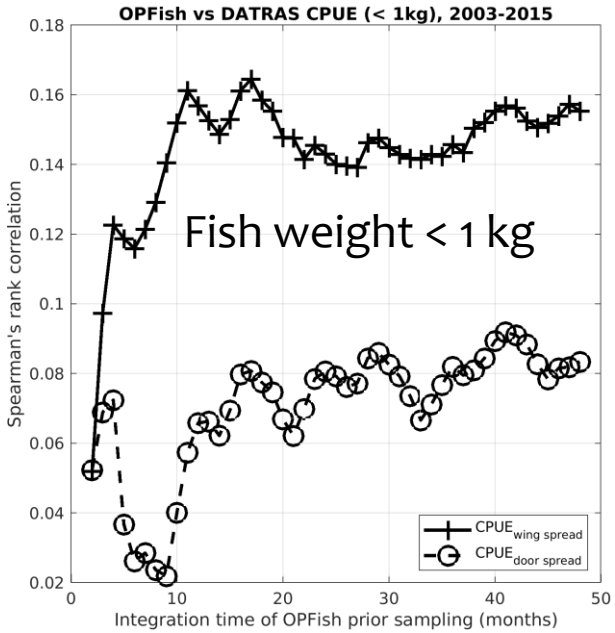
European Commission

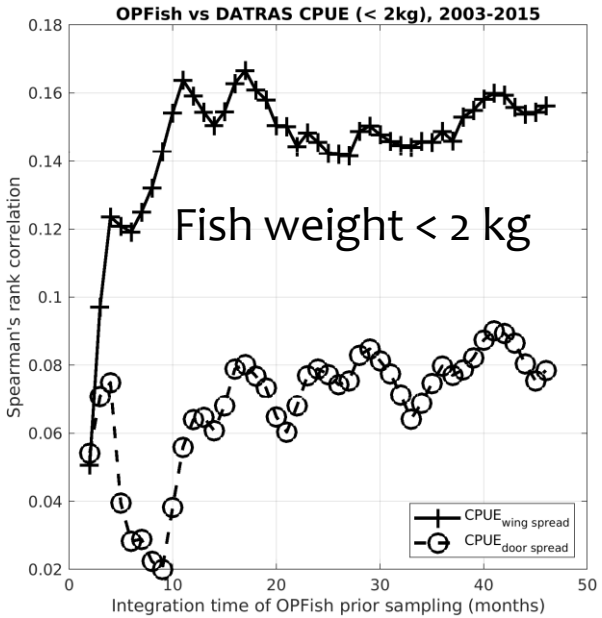
DATRAS CPUE correlation with OPFish increasing integration time

Higher correlation for door spread only for fish weight < 0.05 kg -> role of doors in the catchability of small fish?







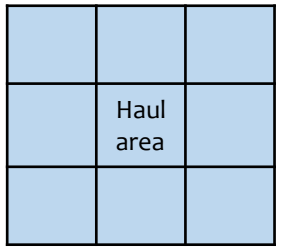


DATRAS

Highest correlation for:

- Fish weight < 0.5 kg but stable above
- OPFish integration time = 16 or 17 months
- 9 pixels of 0.042 deg. centered on haul (the haul pixel leads to r_s = 0.170 for 16/17 months integration): larger fish than MEDITS -> larger integration area (larger fish displacement)

OPFish integration using 3x3 pixels centered on haul



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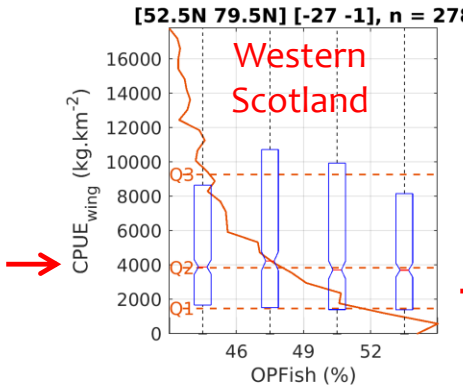
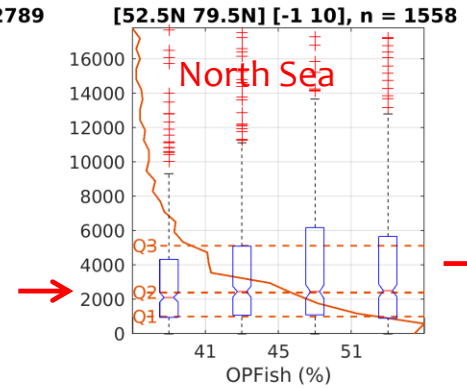
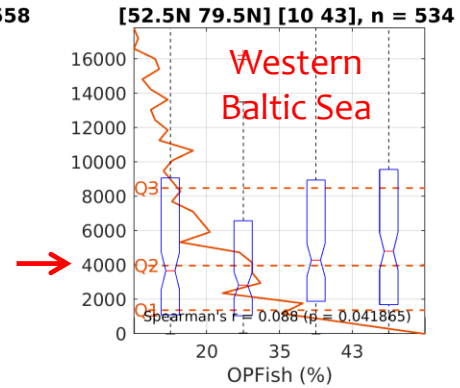
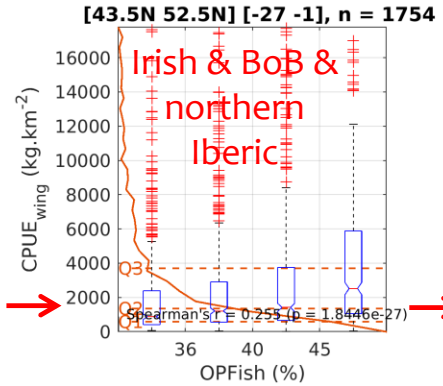
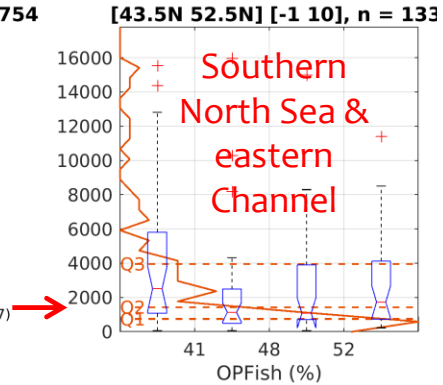
DATRAS CPUE fish weight < 0.5 kg correlation with OPFish 17 months by region

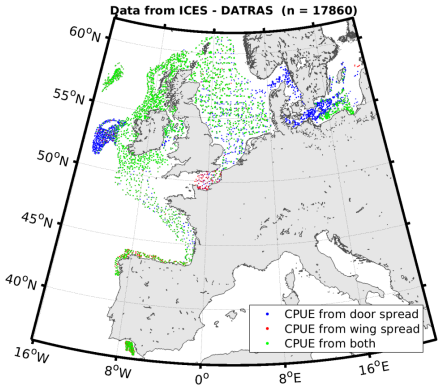


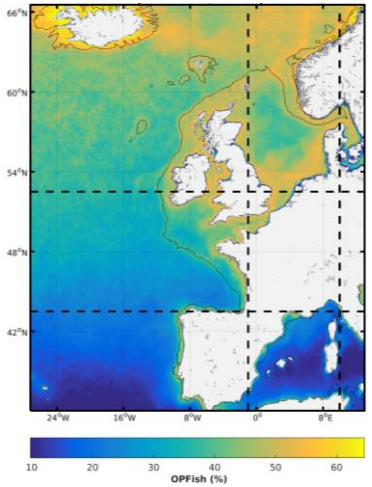


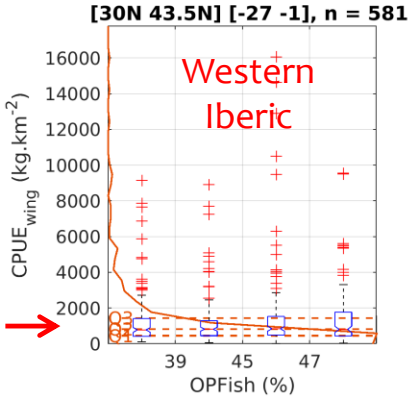






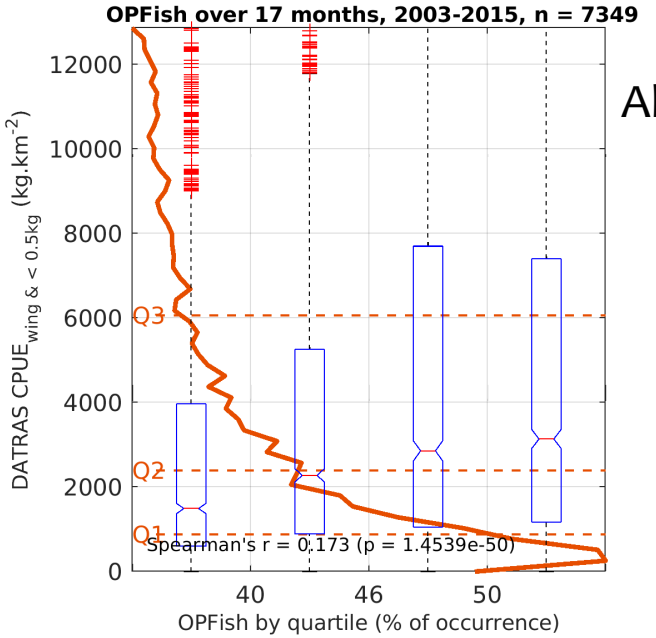




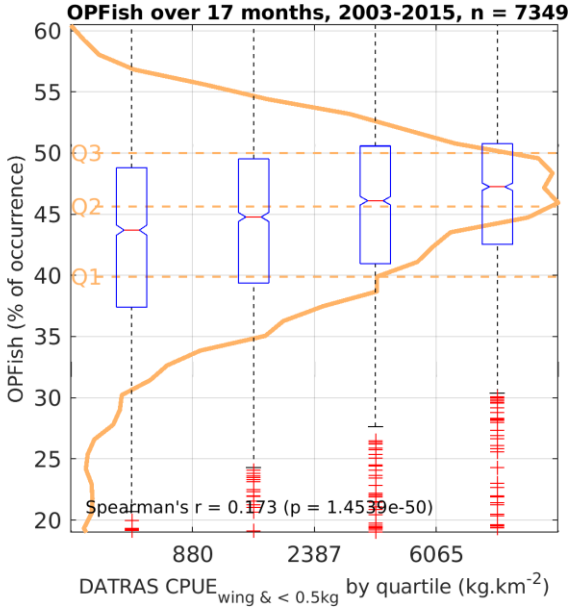


OPFish and/or CPUEs are not contrasted within a region

- more contrasted productivity levels for all regions together.



All regions



All regions reversed boxplot

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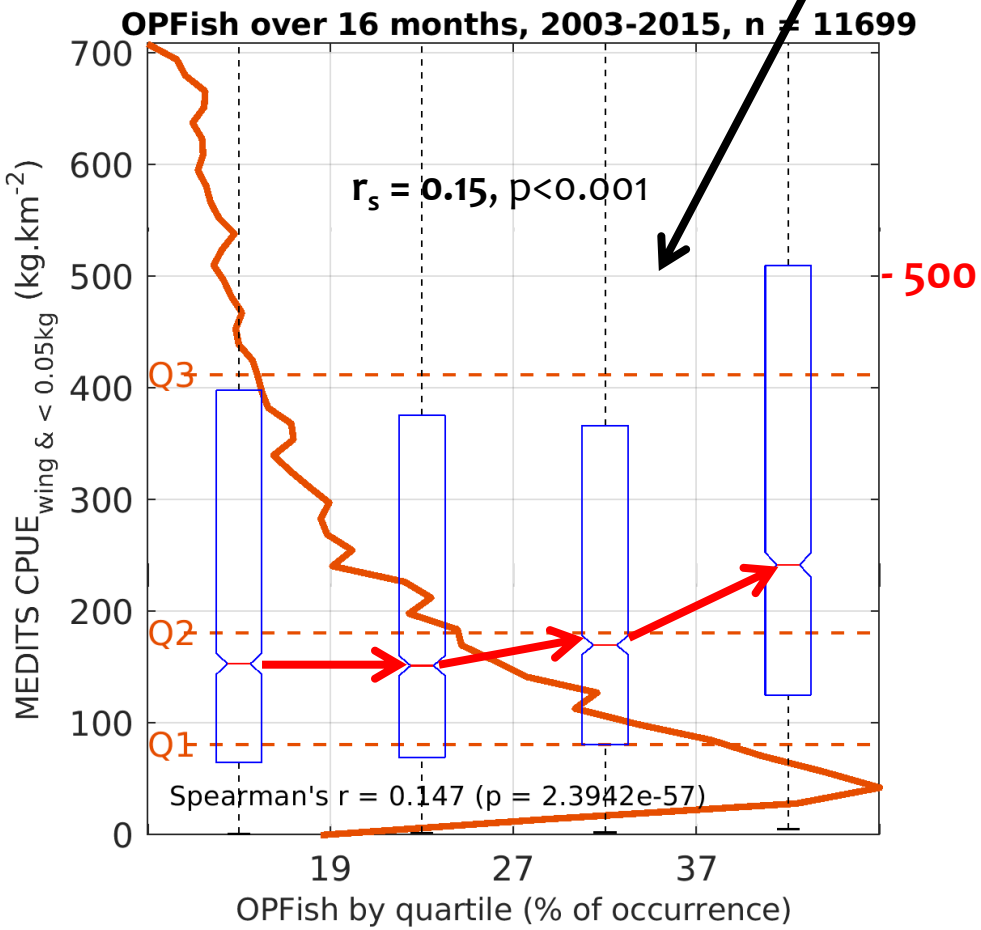
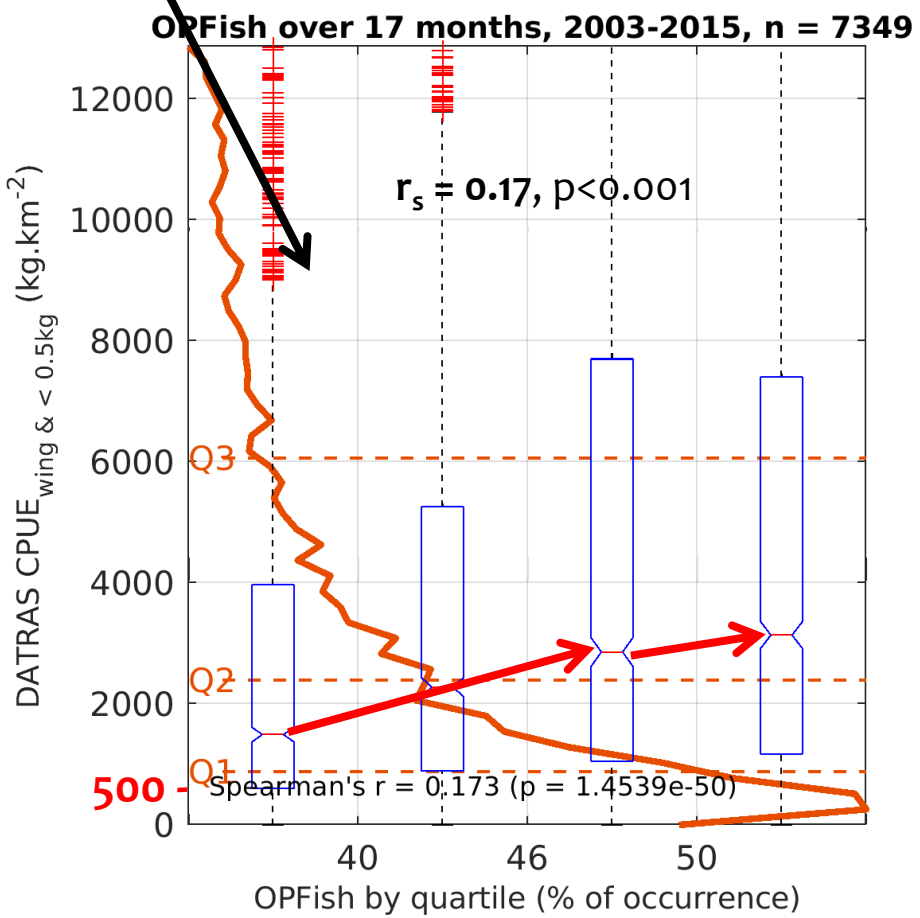
Best correlation of OPFish vs CPUEs from MEDITS and DATRAS





Compared to MEDITS, DATRAS has:
- MUCH larger fish (factor ~10)
- MUCH larger CPUE levels (factor ~10)
- Higher OPFish levels (~ double)

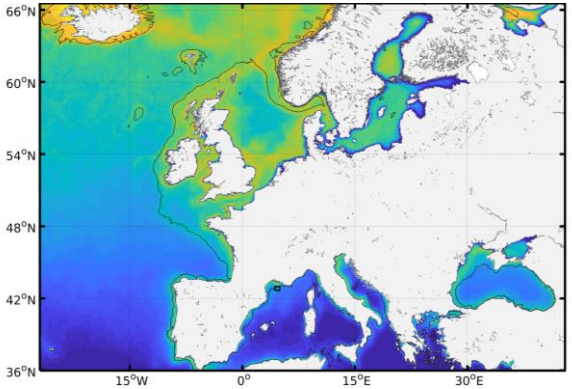
- Same correlation level of both surveys with OPFish
- About the same integration time (16-17 months)
- Overfishing likely reduces the correlation of CPUE with OPFish.

European Commission

OPFish Spearman's r_s and integration time summary table

Spearman's r_s $p<0.001$	Resolution	Gear	LPUE/CPUE All depths (400m, 200m)	Integration time (months) first r_s peaks	Landings	Effort
DCF	0.5x1 deg., quarter	All gears	0.36 (0.23, 0.21)	**14** (11, 20, 23) 18 (**15**, 24) 18 (**15**, 24)	0.57	0.31
DCF	0.5x1 deg., quarter	Pelagic	0.45 (0.60, 0.62)	**14** (12, 24) **14** (24) **14** (26)	0.47	0.11
DCF	0.5x1 deg., quarter	Demersal	0.16 (0.22, 0.32)	8 (11, **14**) 21 (12, 15, 18) 12 (**14**)	0.38	0.31
ICES - WGSFD	0.05 deg., year	Demersal	0.28 (0.35, 0.44)	**14** (15) 20 (**14**) 19 (20, **14**)	0.17	0.05
DATRAS	Mean haul position, day	Bottom trawling	0.17	**17** (11, 16)		
MEDITS	Mean haul position, day	Bottom trawling	0.15	6 (**16**)		

Concluding Remarks 2



- Integration time mostly from 6 (Med) to 26 (Atl) months -> about the lifetime of the caught fish or caught fish+spawning preparation
- There is always a correlation peak from 14 to 16 months
- Higher correlation with OPFish:
  - for pelagic vs demersal fisheries,
  - for larger datasets (commercial vs scientific)
  - at finer scale (0.05 vs 0.5 deg.) for demersal fisheries
  - at shallower depth (shelf)
  - for non over-exploited area.

Further developments:

- Test the increasing correlation with removal of highest effort or lowest LPUE.
- Future use of non over-exploited area data? Contact with New Zealand.
- Future use of 0.5x0.5 deg. annual data (for 2 years) in the Med end of 2019?
- Test Swept Area Ratio (LPUE in kg/km2) for WGSFD data and compare with DATRAS & OPFish.

More information: jean-noel.druon@ec.europa.eu
http://fishreg.jrc.ec.europa.eu/fish-habitat

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Listing bias and limitations

DCF 0.5 deg.:

- Spatial/temporal resolution
- Effort from fishing days to fishing hours,
- Different gears, keep the main ones and the main vessel length class by gear, split by demersal and pelagic species would be beneficial for the OPFish comparison as these two species groups have different dynamics,
- Effort estimate in kWHr from vessel length and (mostly) three length classes,
- Impact of artificial reefs created by oil and gas pipes (fish aggregation, top-down effect Rouse et al. 2017), same for MPAs
- MS declaration,
- Discards not accounted for.

WGSFD 0.05 deg.:

- Annual vs quarter? Yes for pelagic migratory species
- Discards not accounted for.

Scientific surveys:

- Limited spatial and temporal coverage & volume of data,
- Vertical opening (2m MEDITS, 4 m DATRAS) could explain part of the CPUE differences between the Med and NE Atl. -> split by demersal and pelagic species would largely correct from this, it would also be beneficial for the OPFish comparison as these two species groups have different dynamics.

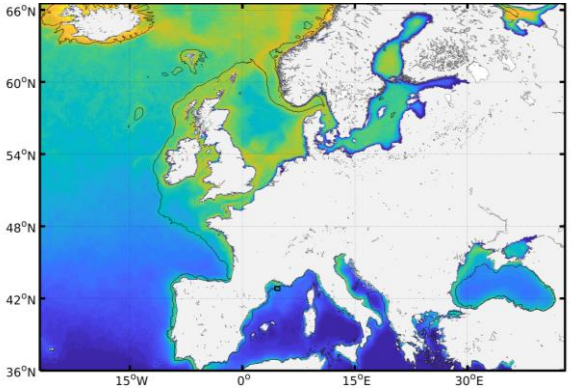
OPFish:

- Clouds and day length at high latitude and in the NE Atl. open ocean,
- Pelagic vs demersal, the deeper the fuzzier,

Fisheries OPFish comparison:

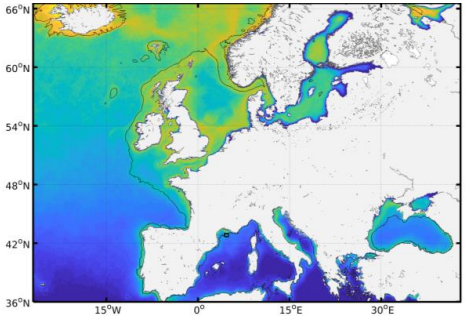
- Impact of over-exploitation on correlation, check F/F_{MSY}
- Missing fisheries data regionally (e.g. Norway, Spain): use a minimum threshold for the effort.

Further actions



- IMBER Future Oceans 2 presentations, June 17-21 2019 Brest
  - *Satellite-derived productive fronts as a common proxy for marine ecosystem productivity across oceans: lessons learnt from a climate-dependent and fisheries-independent indicator.*
  - Is the local fishing effort adapted to the changing fish resources? Confronting LPUE at 0.05-degree resolution in the ICES area and satellite-derived ocean productivity available to fish.
- Potential uses of OPFish in monitoring, research, management and policy:
  - Monitoring of useful productivity for fish that includes the current effect of climate change: spatial changes,
  - Adaptation of total effort to regional productivity on an annual basis,
  - Input data for ecosystem models.

Comments



- Distribution and trend of cloud coverage? ->Mostly regional & seasonal variability
- Derive OPFish trend by region (GSA/ICES division or ecosystem) & full Med
- Longer time-series using SeaWiFS sensor from 1998 to 2010 (2 time-series with MODIS)
- Why not using DCF data since 2003? Antonella: data of substantially lower quality…
- Are species the same over the time series of DCF data? Antonella: Yes, 575 species in total
- Apply a threshold of maximum ESTIMATED depth for DCF bottom gears (central point of 0.5x1 deg.): < 1000 m sounds reasonable, < 500 m for 0.05 deg. data
- Filter the minimum effort (e.g. perc. 5-10th) for computing the LPUE and looking at minimal information - removal of noise
- The "all gears" analysis is too much integrated with incompatible effort – to be removed
- Pelagic and bottom mobile gears also to be separated into main gears – probably removing minor gears (e.g. demersal seine) – and selecting the main length class , check then and eventually combine main gears using GLM and vessel length for catchability estimate (Didier, Laurent),
- DATRAS data also needs to be separated by main gears: probably use IBTS only.
- Demersal data (commercial and scientific) should be processed separating true demersal species from the pelagic species as their dynamics are different. This lies especially for bottom otter trawl – it can a priori be done for DCF-DATRAS-MEDITS while WGSFD data is per métier, which could still be valid. Does it apply to beam trawl? Are pelagic species caught with beam trawl? A check will be done with DCF data. This should also correct from the net vertical opening between DATRAS and MEDITS (4 vs 2 m).

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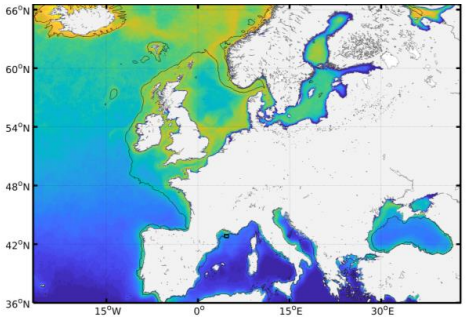
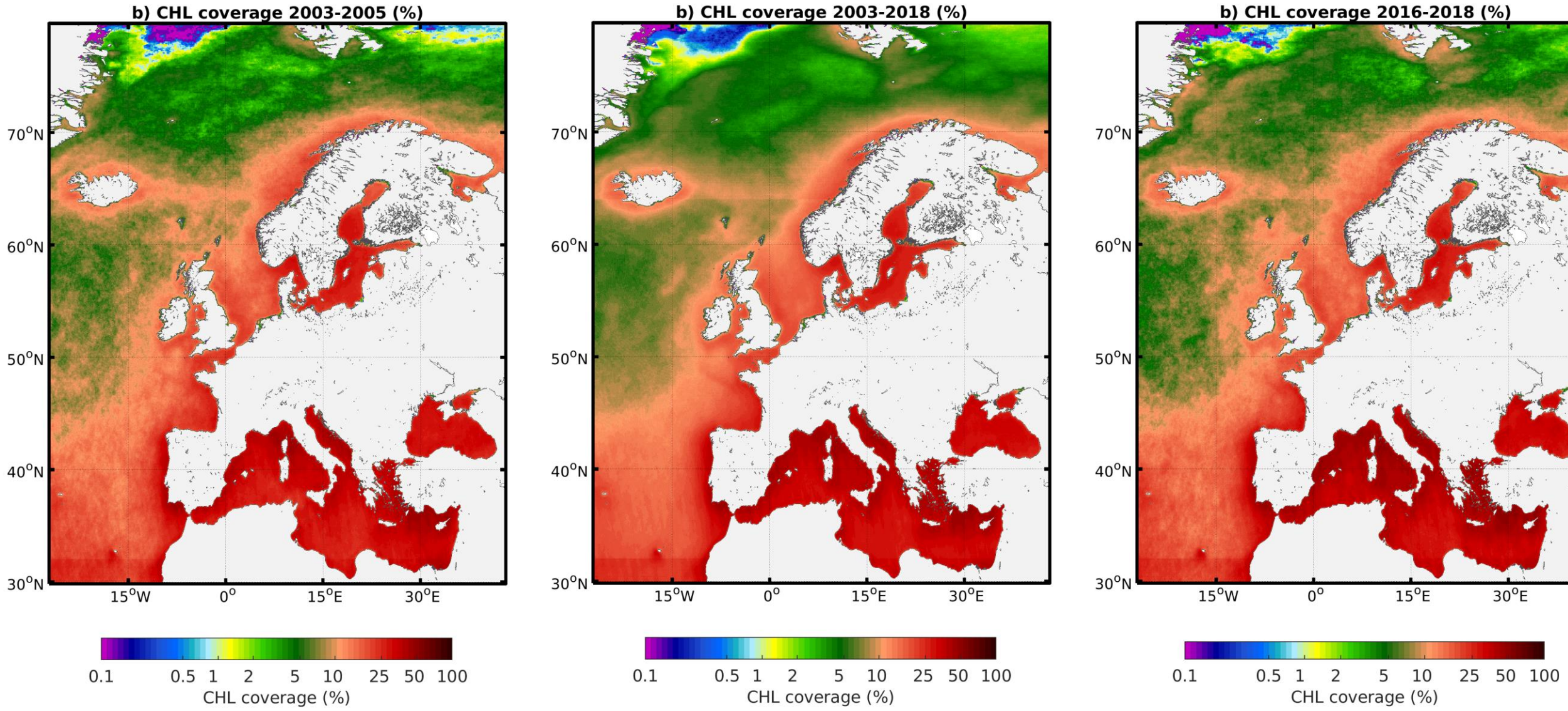
Comments



- Pelagic species are subject to high migration as regards to 14 month time-integration of OPFish: a shorter integration time would have been expected, however 1- although migration is done for spawning and feeding, a major time is presumably spent for feeding (see BFT/habitat animations) and the fleets follow the moving populations, 2- pelagic species are more frequent in regularly productive areas (could be different species along the seasons),
- Removing Baltic Sea for the publications? Likely yes, Issues: CHL estimate due to colored dissolved organic matter, mostly no coverage of the 0.05 deg. fisheries data, pelagic/bottom stock dynamics are very specific linked with bottom anoxia and specific plankton dynamics (cyanobacteria and zooplankton associated),
- AIS-derived effort: coverage issue for time being, no associated landing/catch.
- Only one year of DATRAS data appears to be available in the western Channel.
- Use of FishFrame data (Regional Coordination Group) partial sampling of commercial fisheries: data availability ? (ICES->MS) Laurent
- Use of acoustic data would be good to test: accessibility? Natalia/Joanna



CHL coverage

- Distribution and trend of cloud coverage? ->Mostly regional & seasonal variability

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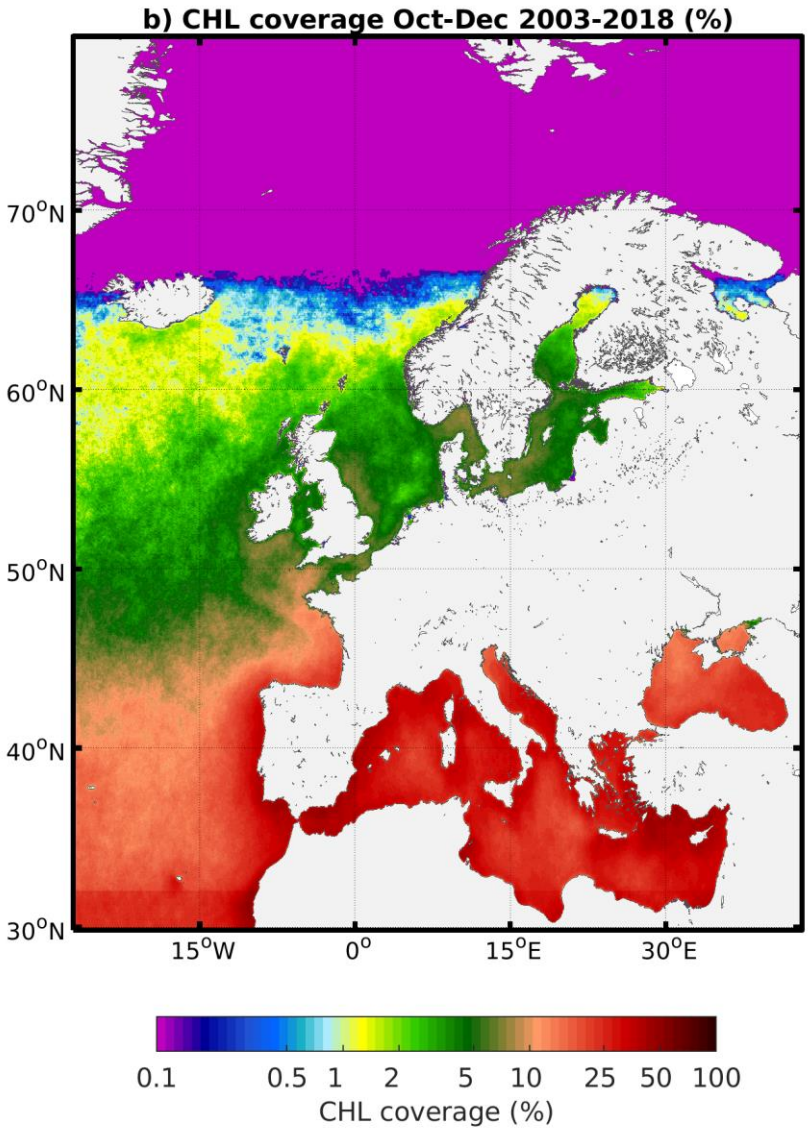
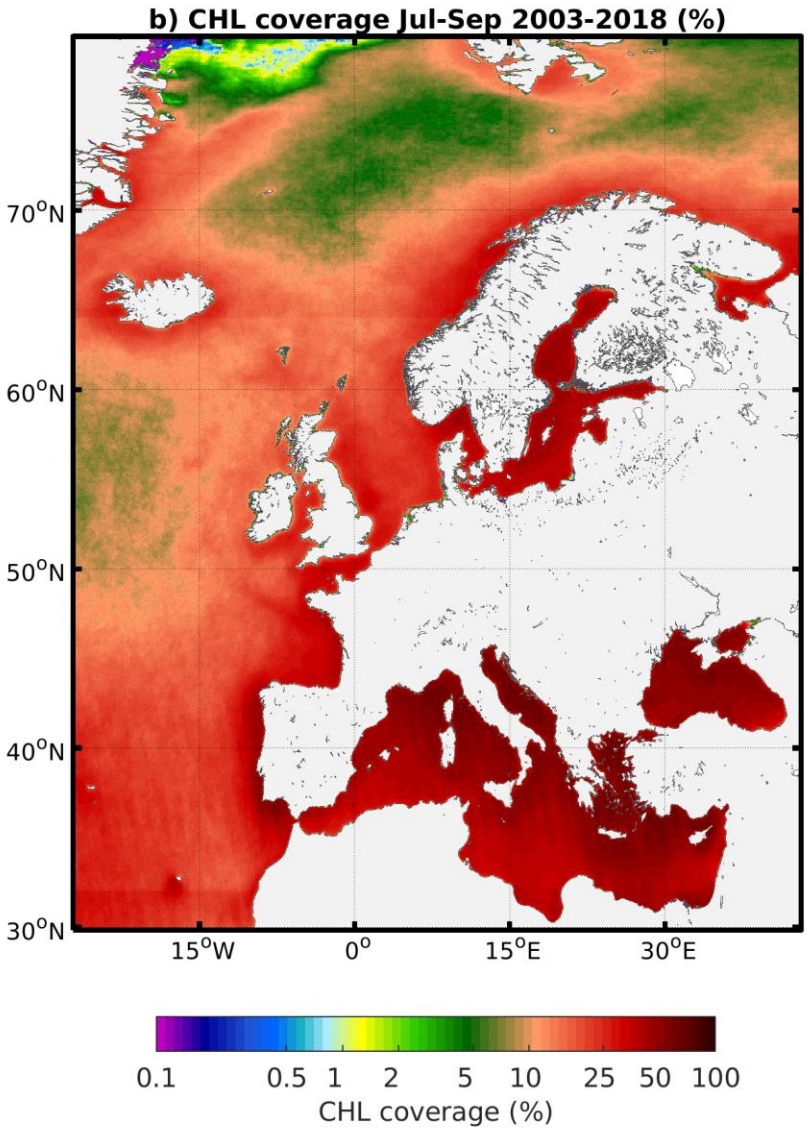


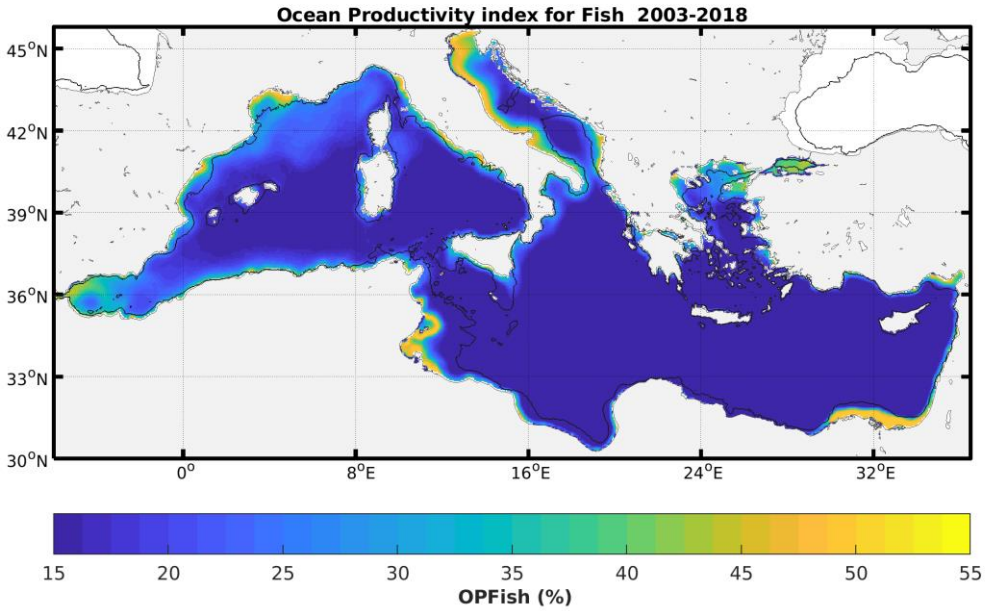


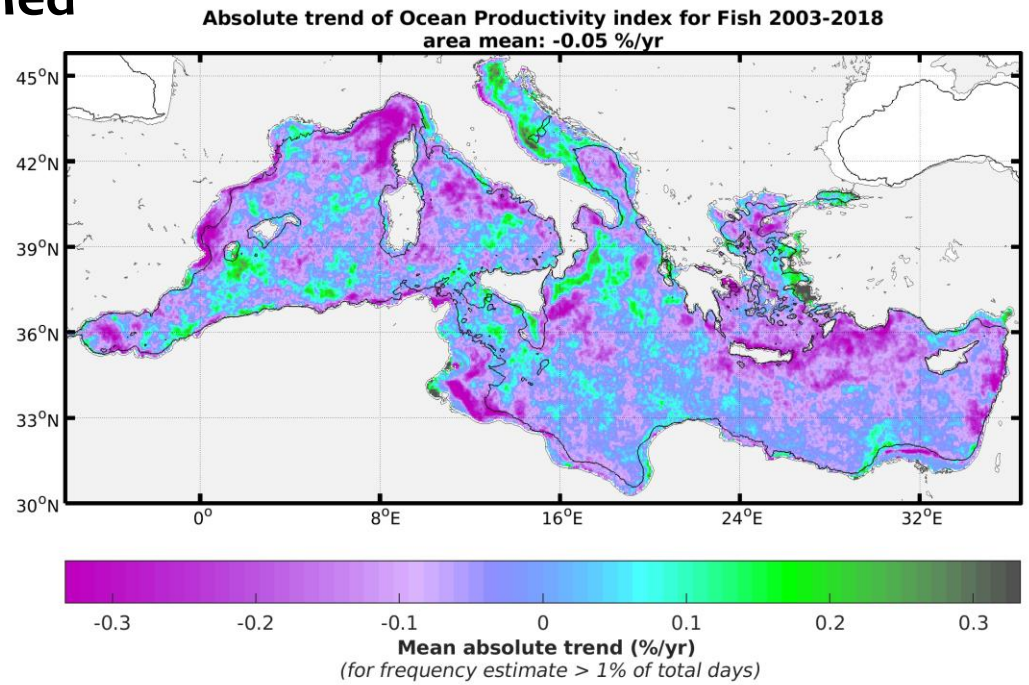
CHL coverage

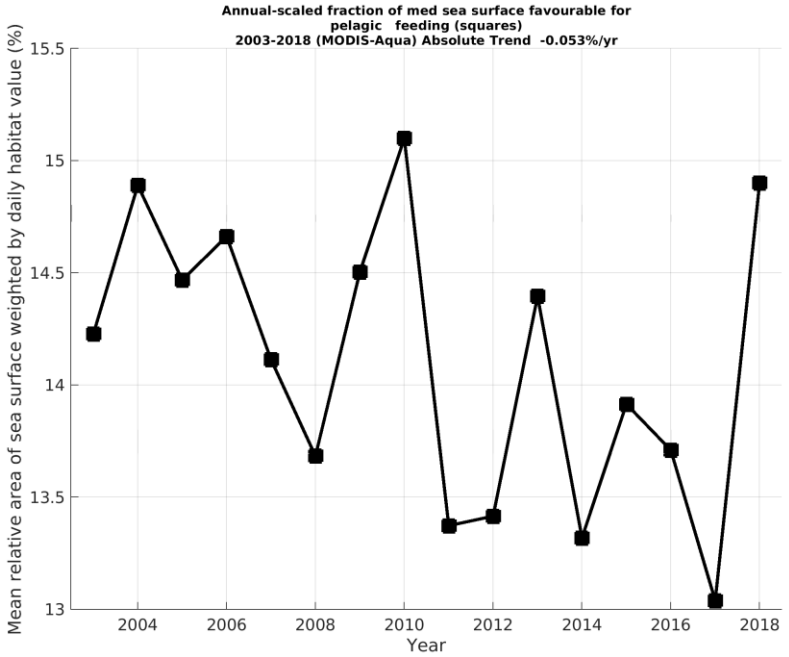
- Distribution and trend of cloud coverage? ->Mostly regional & seasonal variability

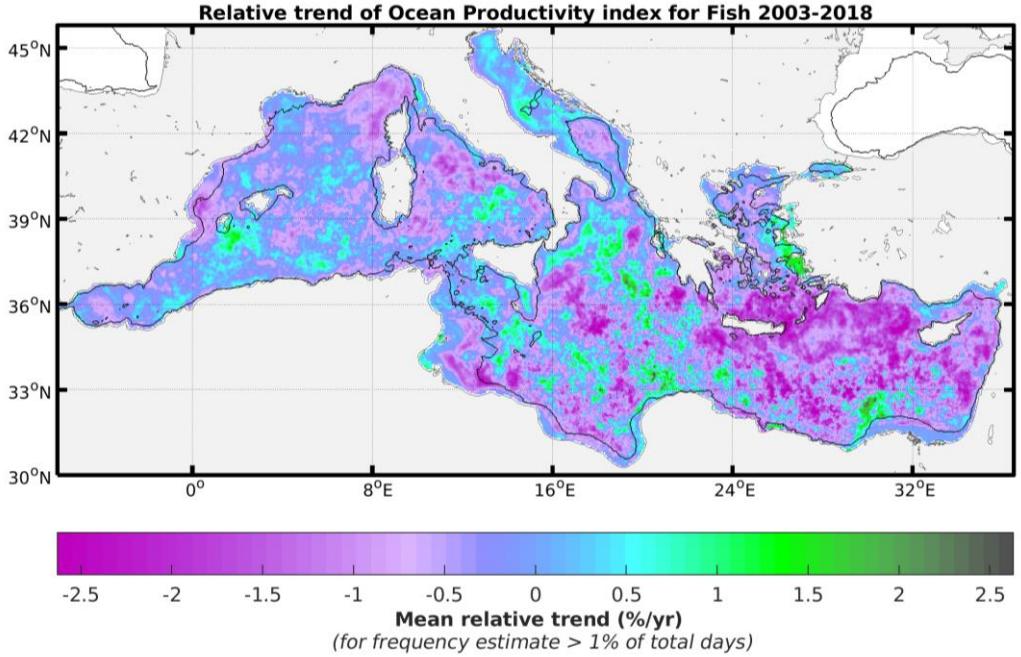
European Commission

OPFish in Med

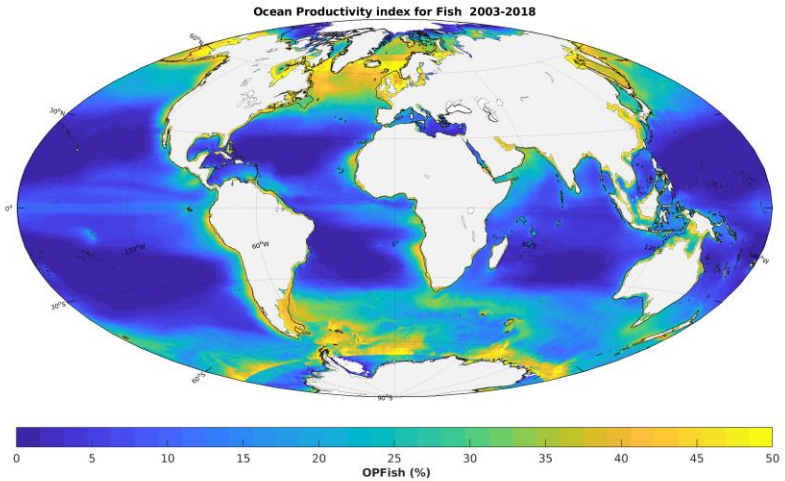


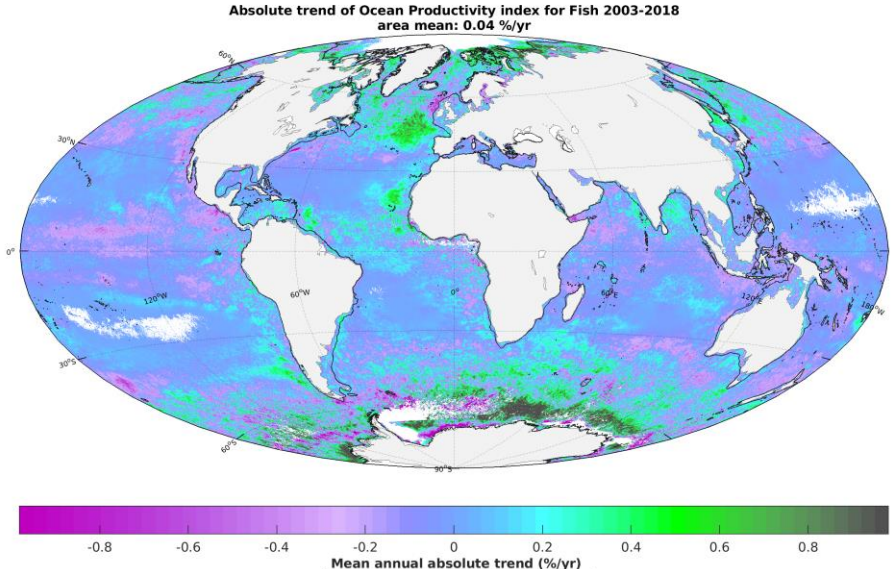


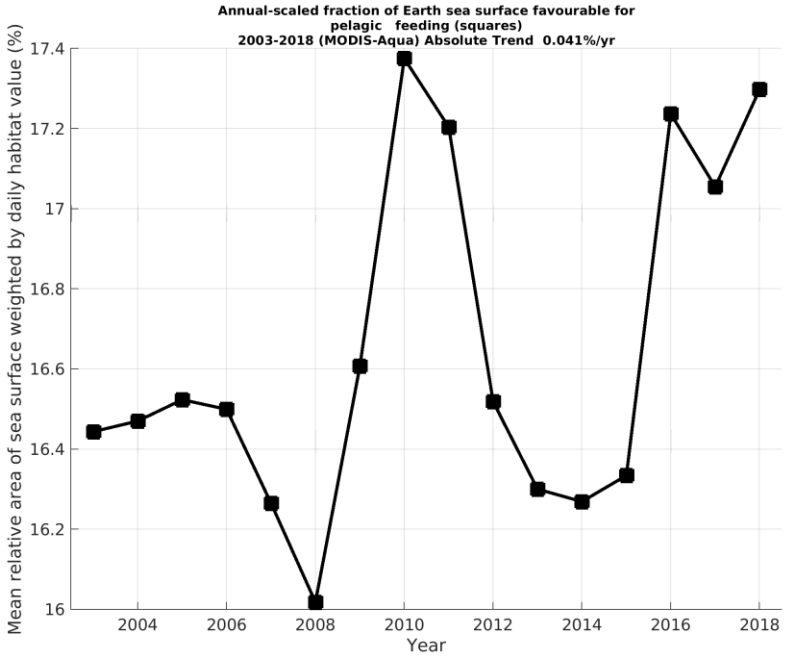


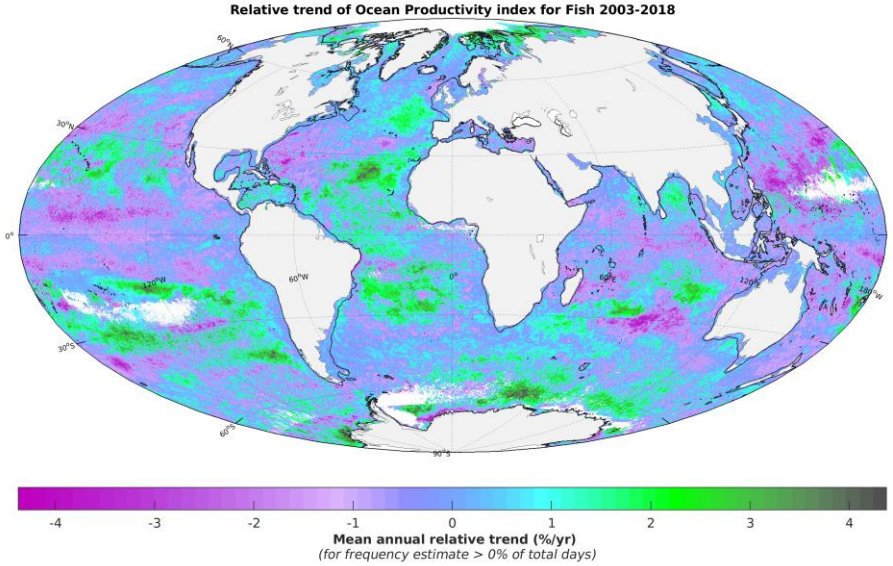


OPFish global







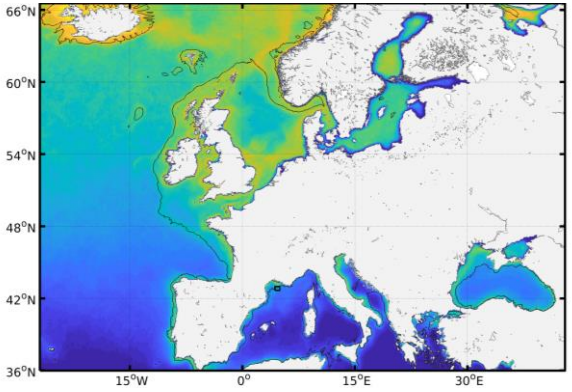


Main way forward: disaggregation and thresholding

Data type	Resolution	Gear	Species groups	Maximum grid depth	Vessel length class	Minimum effort for LPUE/CPUE estimate
DCF pelagic	0.5x1 deg., quarter	Midwater otter trawl	All species (pelagic)	None	The main one 10-15 m > 15 m	Percentile 5 to 10th to test
		Pelagic seine	All species (pelagic)			
DCF demersal	0.5x1 deg., quarter	Bottom otter trawl	Pelagic species	~1000 m to test	The main one 10-15 m > 15 m	Percentile 5 to 10th to test
			Demersal species			
		Beam trawl	Demersal species			
ICES – WGSFD demersal	0.05 deg., year	Bottom otter trawl	Pelagic by métier	~500 m to test	None	Percentile 5 to 10th to test
			Demersal by métier			
		Beam trawl	Demersal by métier			
DATRAS IBTS (also beam trawl?)	Mean haul position, day	Bottom otter trawl	Pelagic species	None	None	None
			Demersal species			
MEDITS	Mean haul position, day	Bottom otter trawl	Pelagic species	None	None	None
			Demersal species			

Further actions

- Publication(s):
  - What are the key messages?
  - 1 or 2 papers? (fisheries data comparison & with OPFish)
  - Which journal? What is the targeted audience?



Comments:

- The resulting idea is to use the cleanest and most abundant fisheries data to compare with OPFish, the latter being comparatively much more consistent in space and time (see table “way forward”).
- Waiting for the outputs of the disaggregation and thresholding of the fisheries data (previous slide), it is difficult to anticipate the key messages.
- A case study in the North Sea is likely to be chosen for a first publication because of the quality and volume of data, and because of relatively contrasted productivity levels.
- It would be good to also perform in parallel a similar analysis in the Med (Adriatic/NW Med?) for comparing really contrasted productivity levels both at regional and European levels.
- Acoustic data are potentially a good candidate for the comparison with OPFish (data volume, consistency and related to pelagic species).