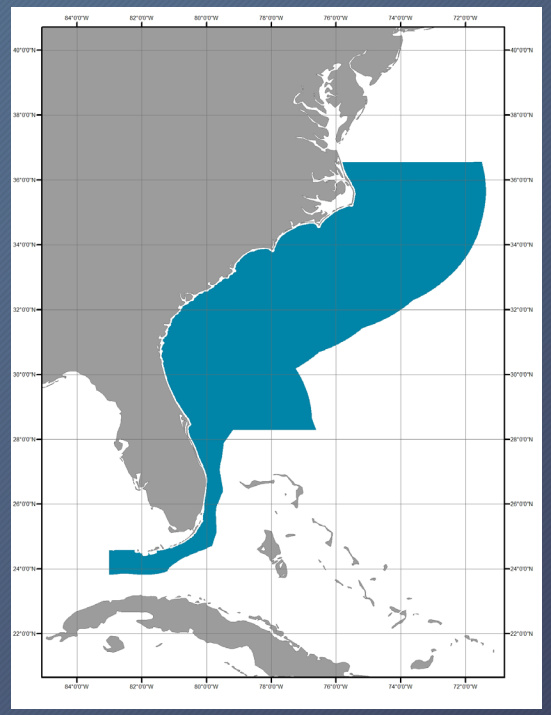
Ecospace Development Update

Luke McEachron
Florida Fish and Wildlife Conservation Commission
St. Petersburg, FL
Luke.McEachron@myfwc.com

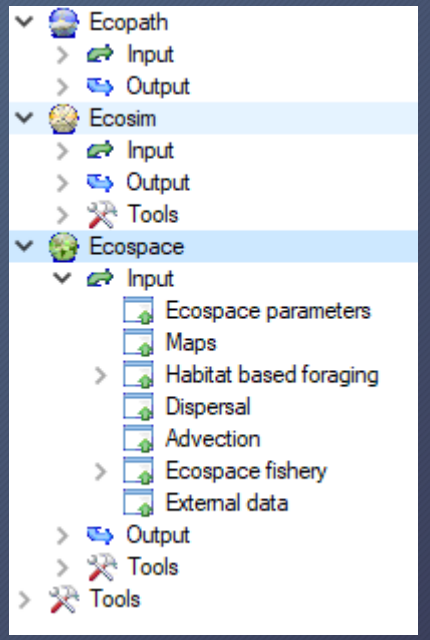
Outline

- Model Background
- Meeting Update
- Model Progress
- Review Panel



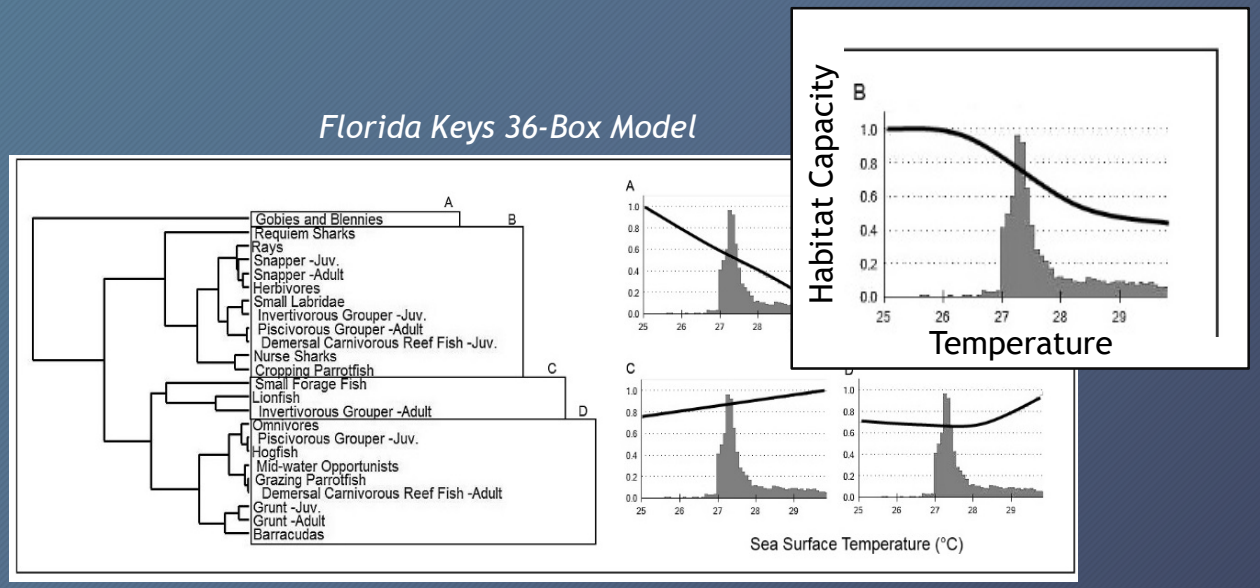
Model Background

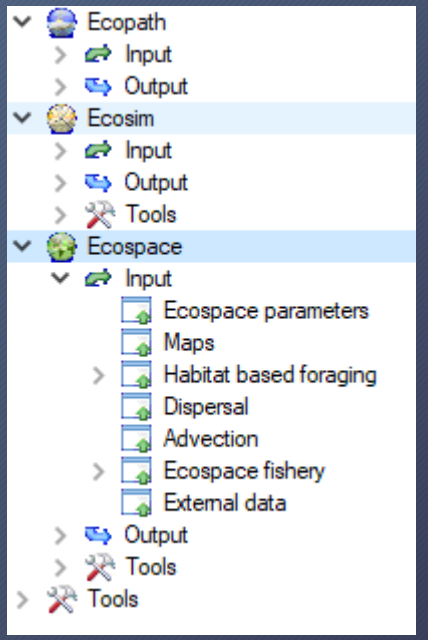
- Ecopath, Ecosim, and Ecospace (EwE)
  - Snapshot in time (Ecopath) ->
  - Trophic dynamics over time (Ecosim) ->
  - Trophic dynamics over time and space (Ecospace)



Model Background

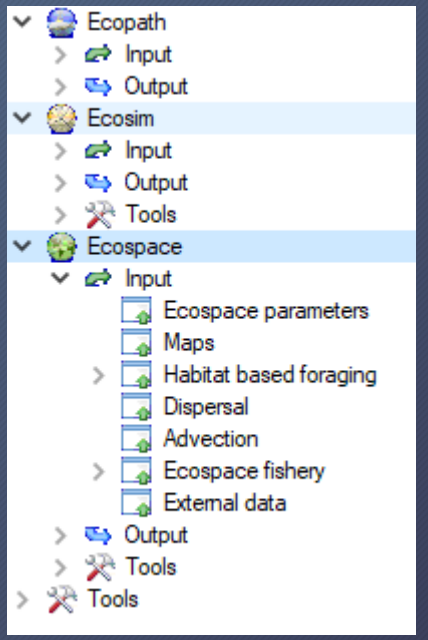
- Ecopath, Ecosim, and Ecospace (EwE)
  - Trophic dynamics over time and space (Ecospace)
    - Habitat Capacity Functions
      - Any raster product with ecological importance





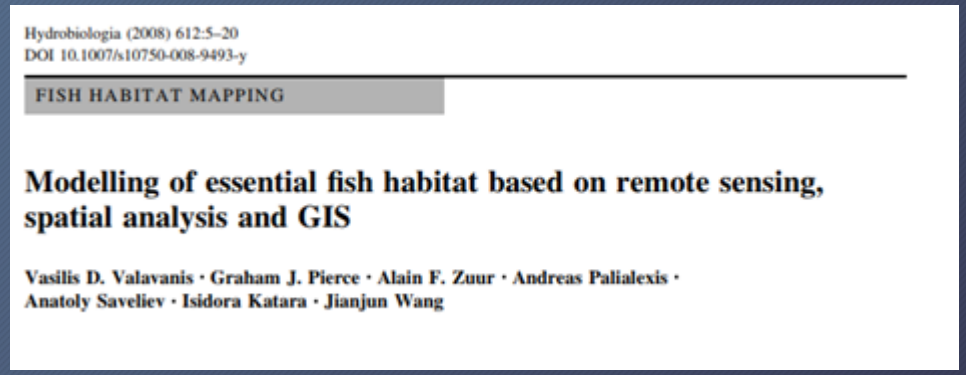
Model Background

- Ecopath, Ecosim, and Ecospace (EwE)
  - Trophic dynamics over time and space (Ecospace)
    - Maps and Environmental Drivers
      - Known environmental relationships
      - Data availability
      - Resolution



July Meeting Outcomes

- Maps and Environmental Drivers
  - Known environmental relationships
  - Data availability
  - Resolution

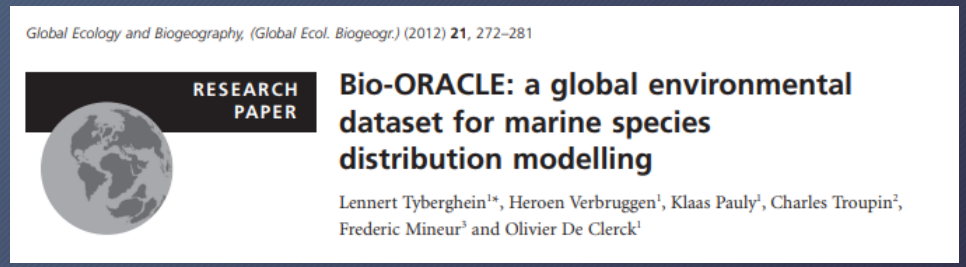


Hydrobiologia (2008) 612:5–20
DOI 10.1007/s10750-008-9493-y

FISH HABITAT MAPPING

Modelling of essential fish habitat based on remote sensing, spatial analysis and GIS

Vasilis D. Valavanis · Graham J. Pierce · Alain F. Zuur · Andreas Palialexis · Anatoly Saveliev · Isidora Katara · Jianjun Wang

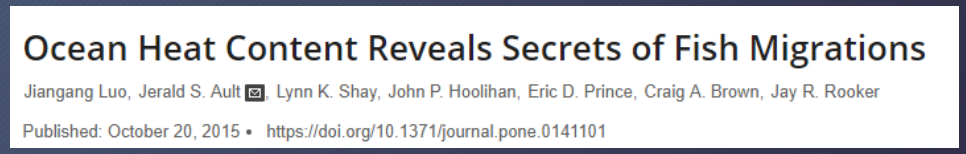


Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2012) **21**, 272–281

RESEARCH PAPER

Bio-ORACLE: a global environmental dataset for marine species distribution modelling

Lennert Tyberghein[1*], Heroen Verbruggen[1], Klaas Pauly[2], Charles Troupin[2], Frederic Mineur[3] and Olivier De Clerck[1]



Ocean Heat Content Reveals Secrets of Fish Migrations

Jiangang Luo, Jerald S. Ault, Lynn K. Shay, John P. Hoolihan, Eric D. Prince, Craig A. Brown, Jay R. Rooker

Published: October 20, 2015 • https://doi.org/10.1371/journal.pone.0141101

July Meeting Outcomes

- Maps and Environmental Drivers
  - Known environmental relationships
    - Discussed ~70 possible covariates
    - Ranked covariates by “importance”

Biochemical

	SST Maximum	SST Mean	SST Minimum	SST Range	SST May Oct	SST Nov Apr	Seabed Temp	Bottom Temp	Salinity	Bottom Salinity	Chla Mean	Chla Max	Chla Min	Chla Range	Chla Sum Max	Chla Win Max	Chla Prim Prod	PAR	pH
SST Maximum	1																		
SST Mean	0.984	1																	
SST Minimum	0.955	0.991	1																
SST Range	0.129	-0.043	-0.169	1															
SST May_Oct	0.968	0.991	0.988	-0.089	1														
SST Nov_Apr	0.969	0.979	0.968	-0.014	0.969	1													
Seabed Temp	0.327	0.298	0.259	0.219	0.283	0.256	1												
Bottom Temp	0.841	0.828	0.801	0.113	0.816	0.824	0.346	1											
Salinity	0.316	0.370	0.393	-0.282	0.370	0.323	0.031	0.354	1										
Bottom Salinity	0.074	0.092	0.103	-0.102	0.088	0.087	-0.108	0.127	0.242	1									
Chla Mean	-0.235	-0.300	-0.341	0.371	-0.315	-0.269	0.303	-0.214	-0.536	-0.162	1								
Chla Max	-0.051	-0.095	-0.126	0.260	-0.103	-0.071	0.212	-0.050	-0.438	-0.103	0.816	1							
Chla Min	-0.008	-0.036	-0.056	0.166	-0.036	-0.012	0.147	-0.006	-0.376	-0.022	0.620	0.715	1						
Chla Range	-0.051	-0.092	-0.119	0.235	-0.100	-0.073	0.189	-0.051	-0.376	-0.111	0.731	0.948	0.465	1					
Chla Sum_Max	-0.030	-0.072	-0.102	0.256	-0.077	-0.048	0.298	-0.013	-0.437	-0.110	0.715	0.713	0.652	0.604	1				
Chla Win_Max	0.003	-0.036	-0.071	0.254	-0.047	-0.046	0.399	-0.022	-0.267	-0.111	0.604	0.544	0.398	0.498	0.618	1			
Chla PrimProd	0.121	0.050	-0.007	0.423	0.031	0.051	0.494	0.119	-0.296	-0.157	0.682	0.525	0.285	0.513	0.526	0.581	1		
PAR	0.892	0.920	0.927	-0.122	0.924	0.907	0.246	0.729	0.322	0.083	-0.230	-0.036	-0.008	-0.032	-0.030	-0.022	0.062	1	
pH	0.446	0.429	0.409	0.106	0.423	0.429	0.010	0.438	0.205	0.013	-0.260	-0.151	-0.172	-0.108	-0.198	-0.113	-0.088	0.354	1

Hydrobiologia (2008) 612:5–20
DOI 10.1007/s10750-008-9493-y

FISH HABITAT MAPPING

Modelling of essential fish habitat based on remote sensing, spatial analysis and GIS

Vasilis D. Valavanis · Graham J. Pierce · Alain F. Zuur · Andreas Palialexis · Anatoly Saveliev · Isidora Katara · Jianjun Wang

Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2012) **21**, 272–281

RESEARCH PAPER

Bio-ORACLE: a global environmental dataset for marine species distribution modelling

Lennert Tyberghein[1]*, Heroen Verbruggen[1], Klaas Pauly[2], Charles Troupin[2], Frederic Mineur[3] and Olivier De Clerck[1]

Ocean Heat Content Reveals Secrets of Fish Migrations

Jiangang Luo, Jerald S. Ault, Lynn K. Shay, John P. Hoolihan, Eric D. Prince, Craig A. Brown, Jay R. Rooker

Published: October 20, 2015 • https://doi.org/10.1371/journal.pone.0141101

July Meeting Outcomes

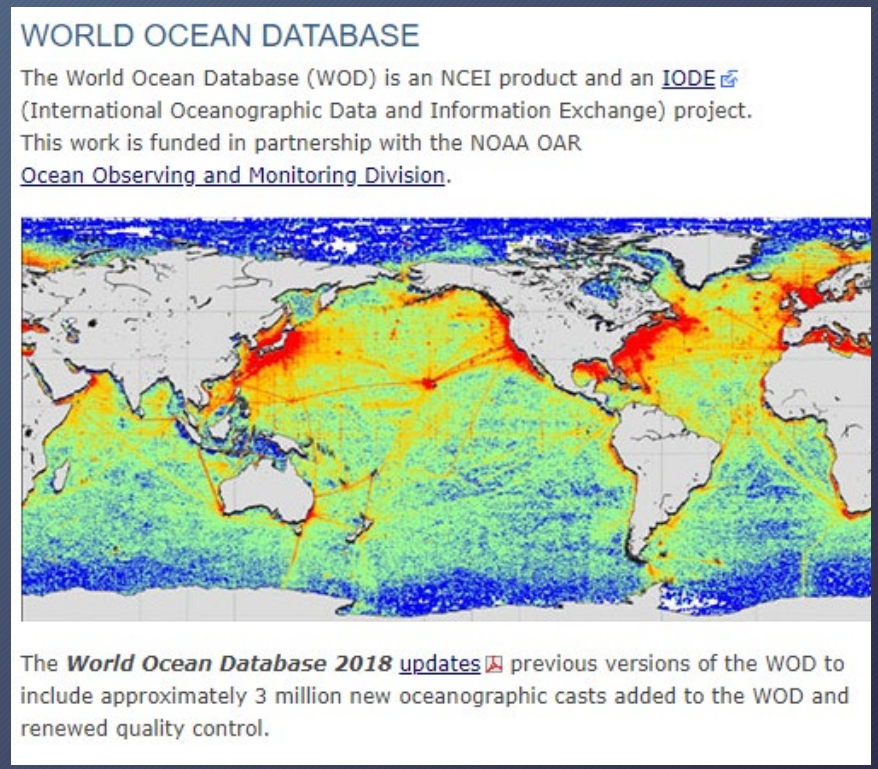
- Maps and Environmental Drivers
  - Known environmental relationships
    - Discussed ~70 possible covariates
    - Ranked covariates by “importance”

#	Importance	Environmental Driver or Covariate
1	1	Depth
2	1	Temperature
3	2	Current Velocity
4	3	Salinity
5	3	DO Range
6	4	Ph

July Meeting Outcomes

- Maps and Environmental Drivers
  - Known environmental relationships
  - Data availability

#	Importance	Environmental Driver or Covariate	Source	Resolution	Temporal Res.
1	1	Depth	SAFMC, FWC	TBD	
2	1	Temperature	NASA (Aqua-MODIS)	4 Km	2002 -
3	2	Current Velocity	Model Derived (NEMO)	9 Km	
4	3	Salinity	Model Derived (NEMO, WOD)	9 Km	
5	3	DO Range	WOD Interpolation	TBD	TBD
6	4	Ph	WOD Interpolation	TBD	TBD



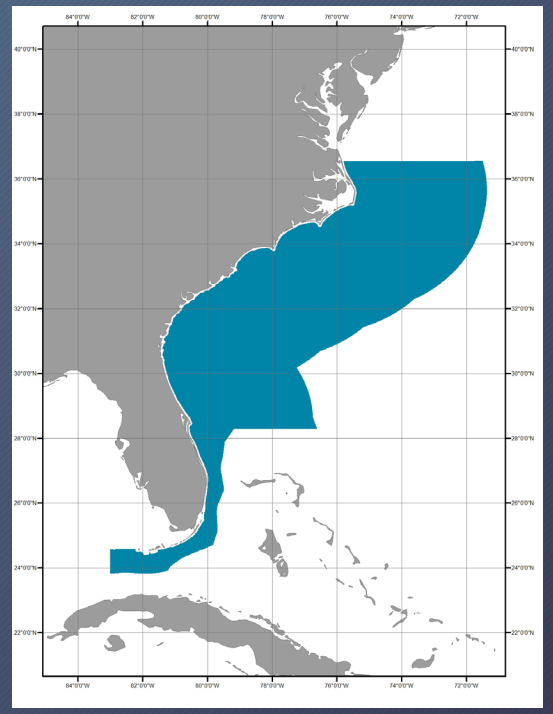
July Meeting Outcomes

- Maps and Environmental Drivers
  - Known environmental relationships
  - Data availability
    - 27 trophic groups and counting

Group Name	*Scientific name*	Representative species	DO Range	DO mean	Depth Range	Depth mean	Salinity Range	Salinity mean	Current Velocity range	Current velocity mean	Temperature range	Temperature mean	Ph range
Coastal bottlenose dolphin	*Tursiops truncatus (coastal ecotype)*	Coastal bottlenose dolphin											
Offshore dolphins	*Tursiops truncatus (offshore ecotype)*	Offshore bottlenose											
	Delphinus spp.	Common dolphin											
Pilot whales	*Globicephala macrorhynchus*	Short-finned pilot whale											
Beaked whales	*Mesoplodon bidens*	Sowerby's beaked whale											
	Ziphius cavirostris	Cuvier's beaked whale											
Sperm whales	*Physeter macrocephalus*	Sperm whale											
	Kogia simus	Dwarf sperm											
Baleen whales	*Megaptera novaeangliae*	Humpback whales											
Manatees	*Trichechus manatus latirostris*	Florida manatee											
Planktivorous sharks	*Rhincodon typus*	whale shark											
	Cetorhinus maximus	basking shark											
Large coastal sharks	*Carcharhinus leucas*	bull shark			10-50m	30 m	0->30%				11->30		
	Carcharhinus obscurus	dusky shark											
Small coastal sharks	*Rhizoprionodon terraenovae*	Atlantic sharpnose shark											
	Sphyrna tiburo	bonnethead											
Dogfish sharks	*Mustelus canis*	smooth dogfish											
	Hexanchus griseus	sixgill shark											
Pelagic sharks	*Isurus oxyrinchus*	shortfin mako											
	Sphryna lewini	scalloped hammerhead											
Pelagic rays	*Rhinoptera bonasus*	cownose ray											
	Manta birostris	Atlantic manta ray											
Demersal rays/skates	*Raja eglanteria*	clearnose skate											
	Dasyatis sayi	bluntnose stingray											
Adult king mackerel	*Scomberomorus cavalla*	king mackerel											
Juvenile king mackerel	*Scomberomorus cavalla*	king mackerel											
Spanish mackerel	*Scomberomorus maculatus*	Spanish mackerel			10-50m	30 m	18->30%				21->30		
Juv Spanish mackerel	*Scomberomorus maculatus*	Spanish mackerel			10-50m	30 m	.5->30%				11->30		
Bluefish	*Pomatomus saltatrix*	bluefish			10-200m	105 m	18->30%				16-25	20.5	

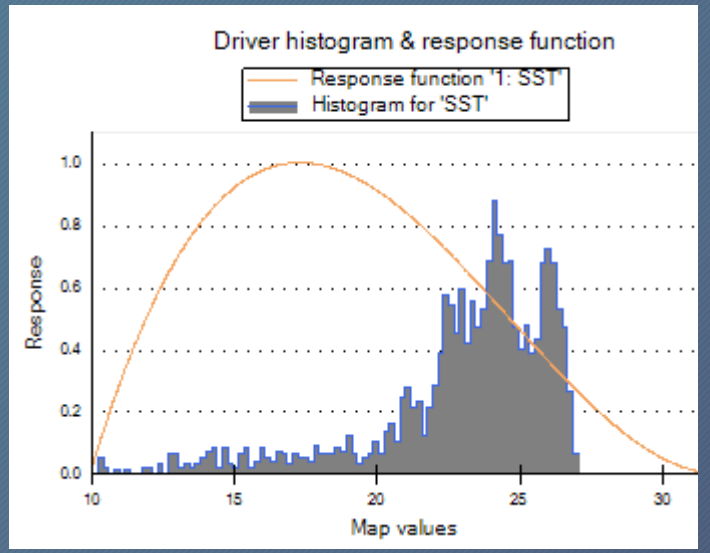
Trial Run in Ecospace

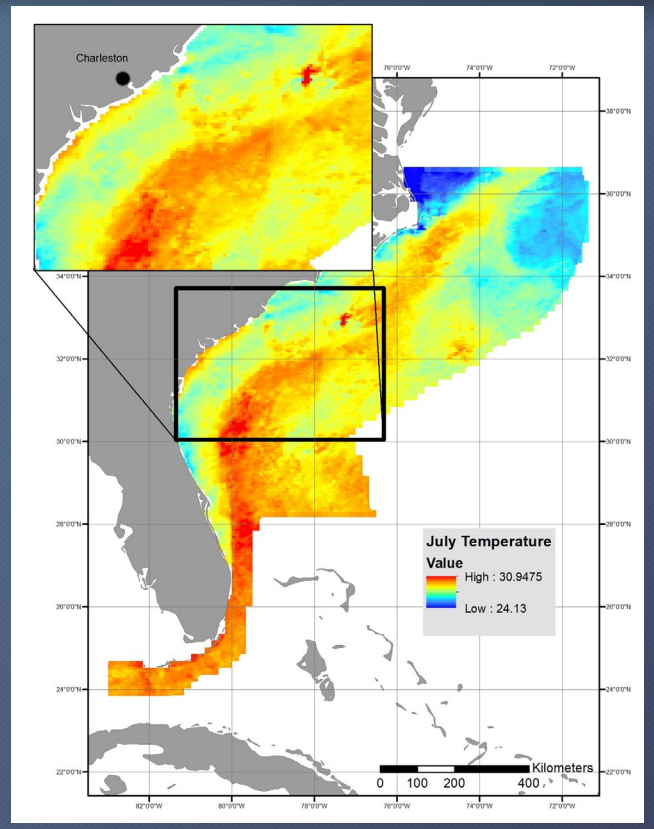
- Identify potential computational and logistical issues
- Establish base extent maps



Trial Run in Ecospace

- Sea Surface Temperature
  - 4 Km MODIS SST, one year (2017)

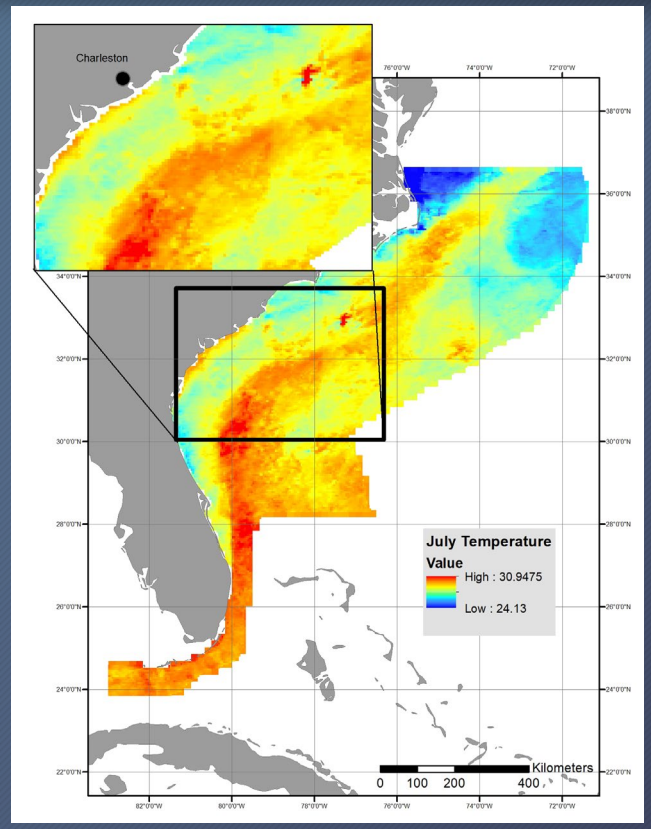




4 Km. Resolution

Trial Run in Ecospace

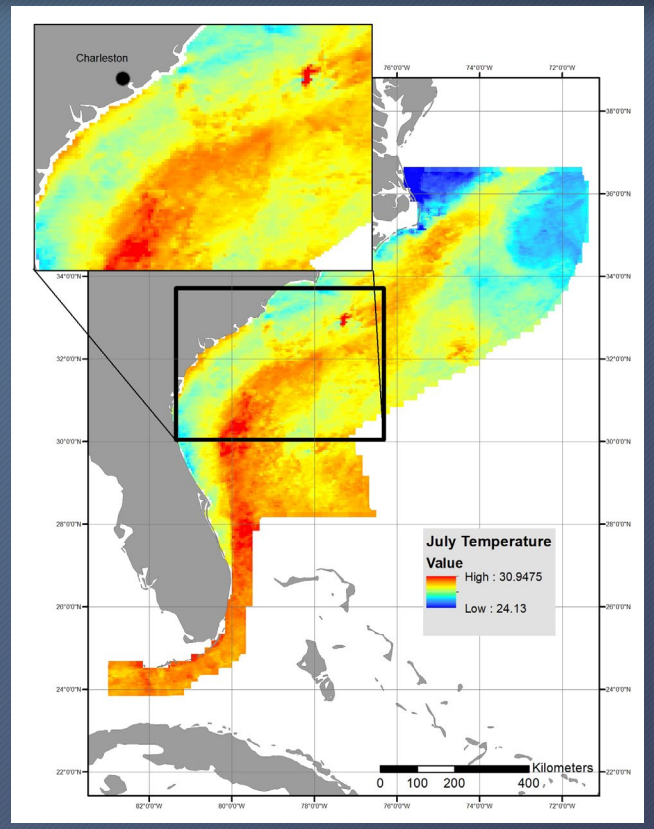
- Sea Surface Temperature
  - ~~4 Km MODIS SST, one year (2017)~~
  - 15 Km MODIS SST, one year (2017)



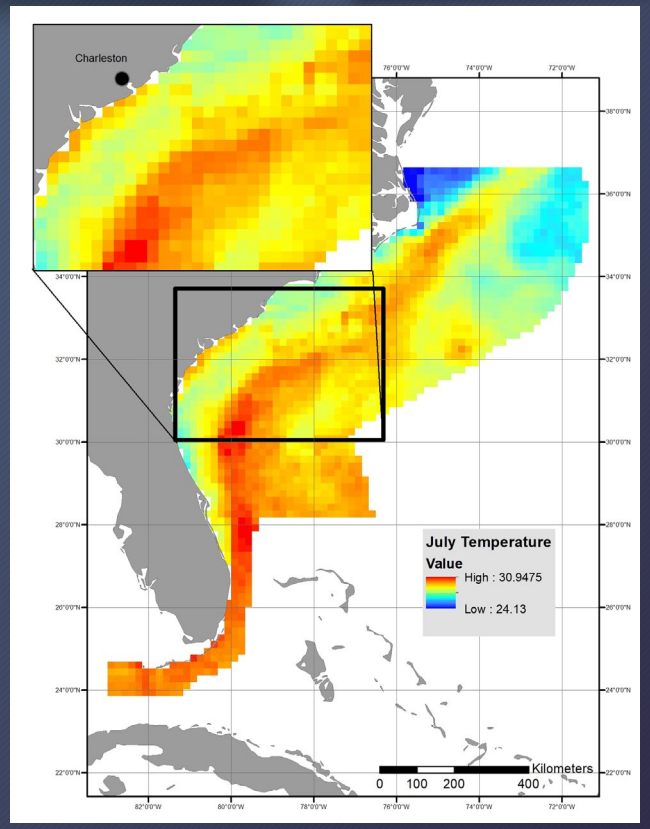
4 Km. Resolution

Trial Run in Ecospace

- Sea Surface Temperature
  - ~~4 Km MODIS SST, one year (2017)~~
  - 15 Km MODIS SST, one year (2017)



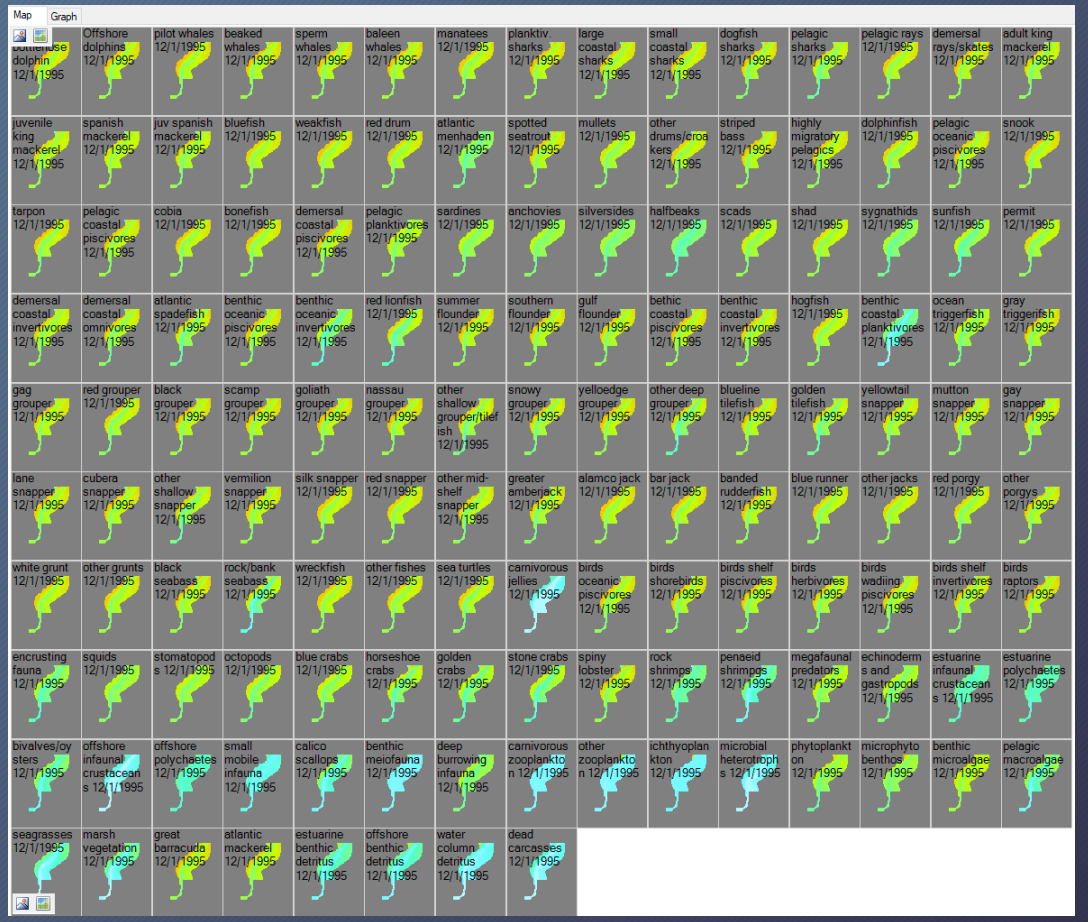
4 Km. Resolution



15 Km. Resolution

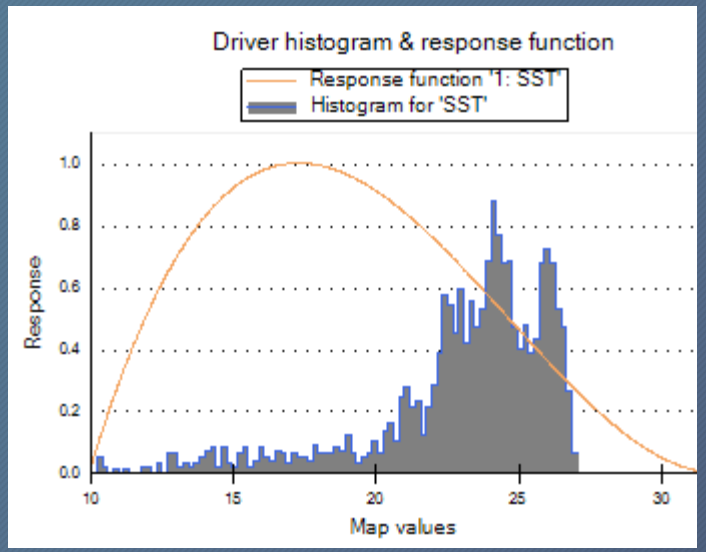
Trial Run in Ecospace

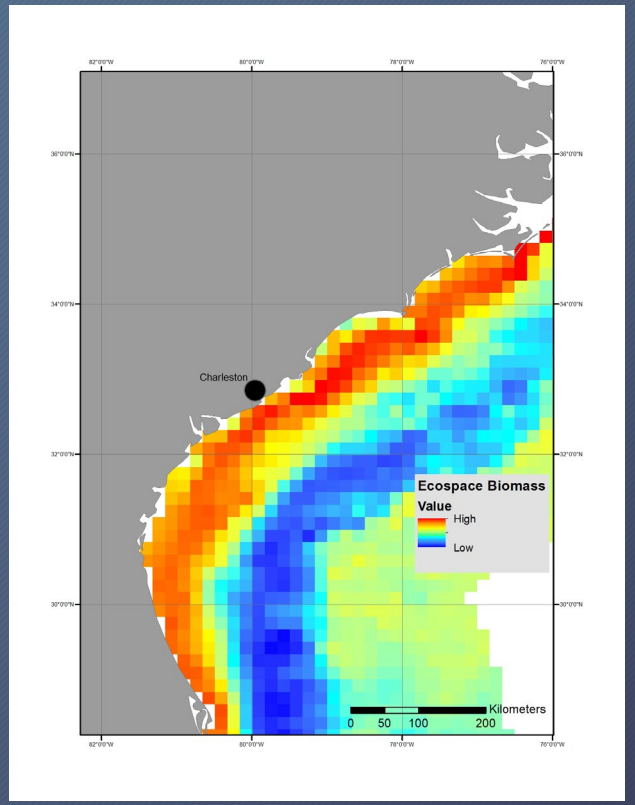
- Sea Surface Temperature
  - ~~4 Km MODIS SST, one year (2017)~~
  - 15 Km MODIS SST, one year (2017)

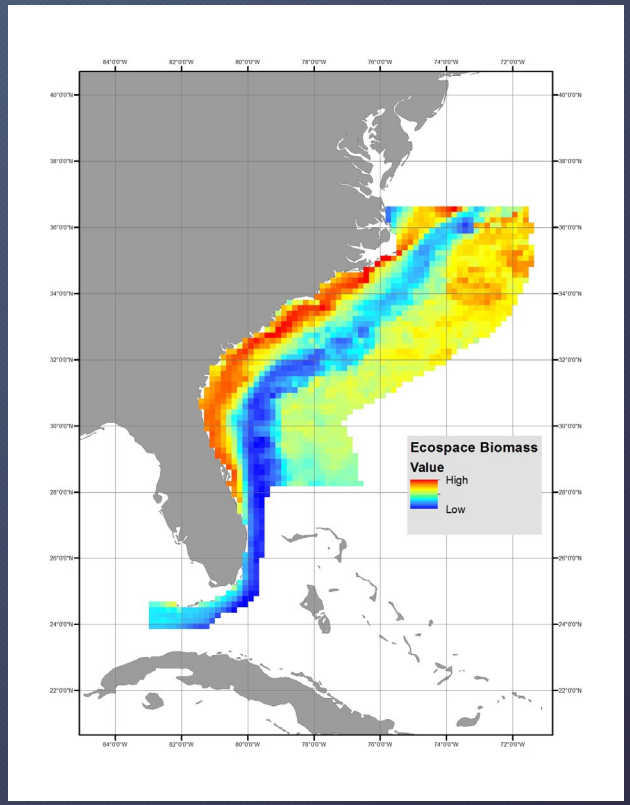


Trial Run in Ecospace

- Sea Surface Temperature
  - ~~4 Km MODIS SST, one year (2017)~~
  - 15 Km MODIS SST, one year (2017)







15 Km. Resolution

Timeline Moving Forward

- Review panel webinar Nov/Dec
  - Ecopath and Ecosim balancing
- Continue to investigate environmental relationships and data availability given resolution tradeoffs
- Ecospace development update April 2020 SSC meeting