Regionalization of Gulf of Mexico using SST and Chlorophyll-a images

Olivia Salmerón-García
osg@igg.unam.mx
Raúl Aguirre-Gómez
raguirre@igg.unam.mx

Laboratorio de SIGPR

IG
INSTITUTO DE GEOGRAFÍA
U N A M

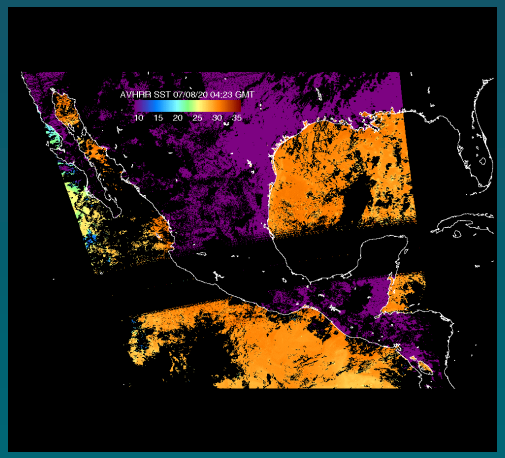
Outline

- Ground Receiving Station
- Study area: The Gulf of Mexico (GM)
- Why regionalize the GM ?
- Why using Sea Surface Temperature (SST) and Chlorophyll-a Concentration [Chl-a] images
- SST and [Chl-a] composites and anomalies
- Empirical Orthogonal Functions (EOF)
- Regions

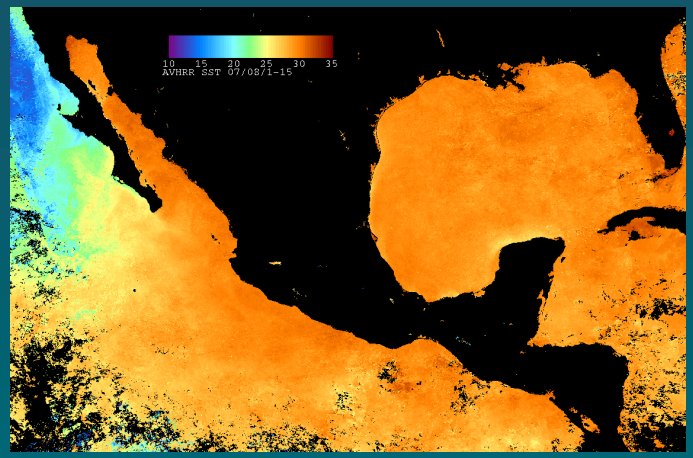
Ground Receiving Station

- It was Installed in 1996
- AVHRR (1996 – to date), SeaWiFS (1998-2004) and GOES (2002 – to date)
- Products
  - Sea Surface Temperature (SST), Normalized Difference Vegetation Index (NDVI), Forest fires and Hot spot detection
  - Chlorophyll-a concentration
  - Cloud detection and Hurricane tracking

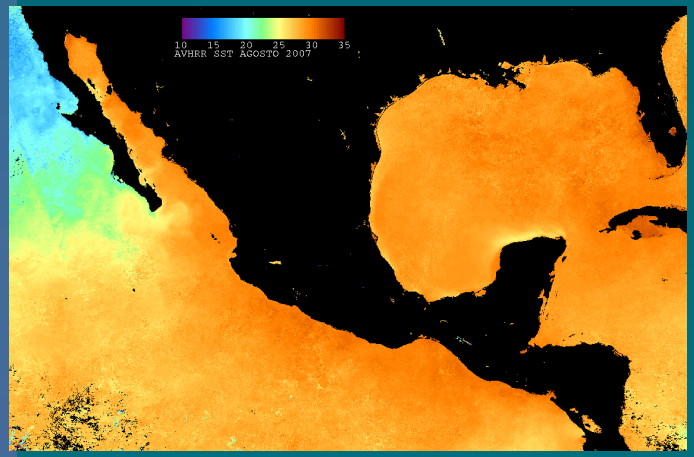
SST imagery



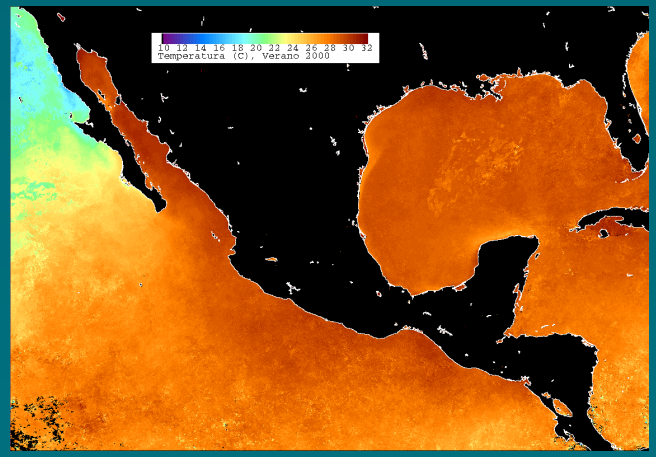
DAILY



FORTNIGHTLY

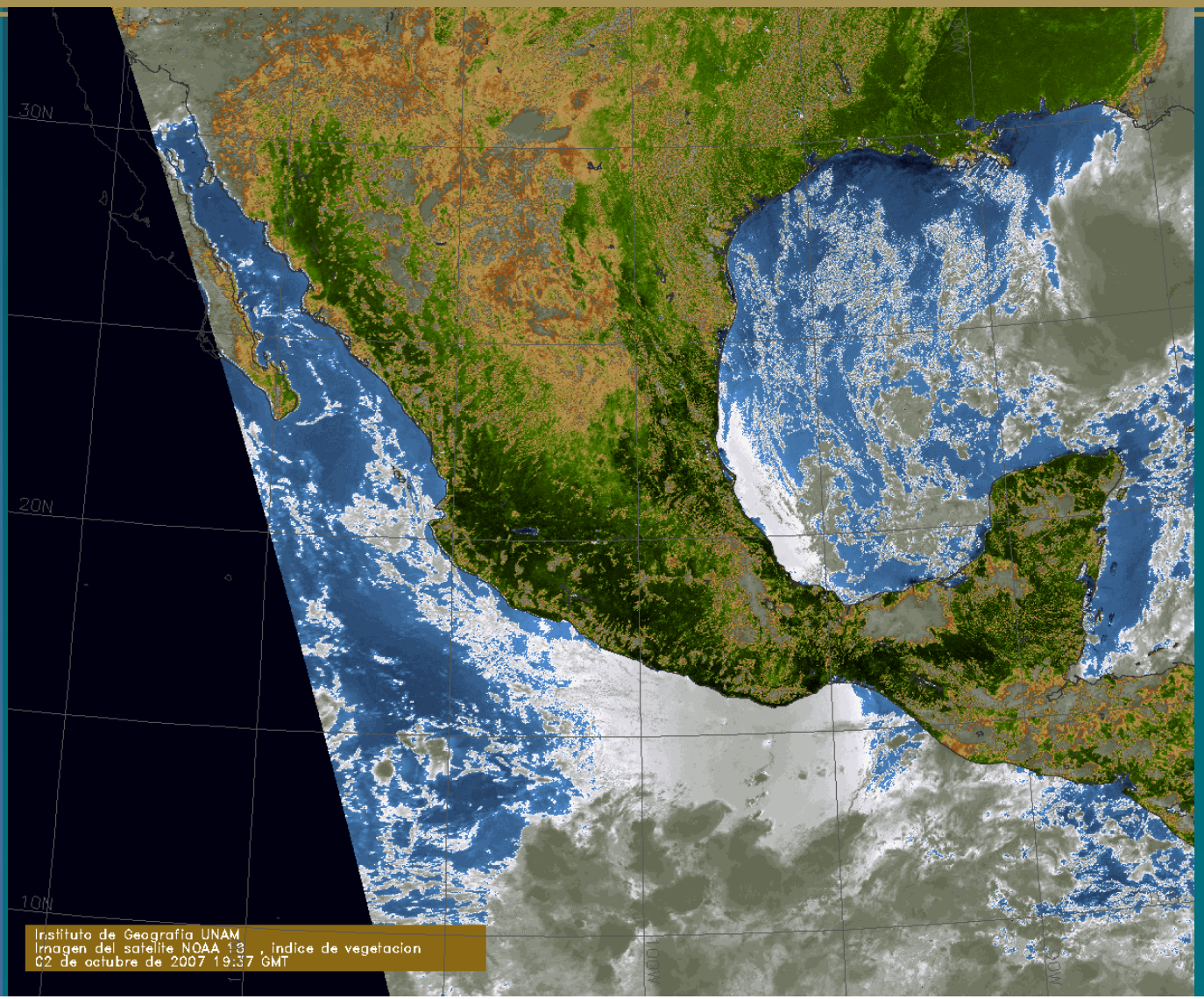


MONHTLY

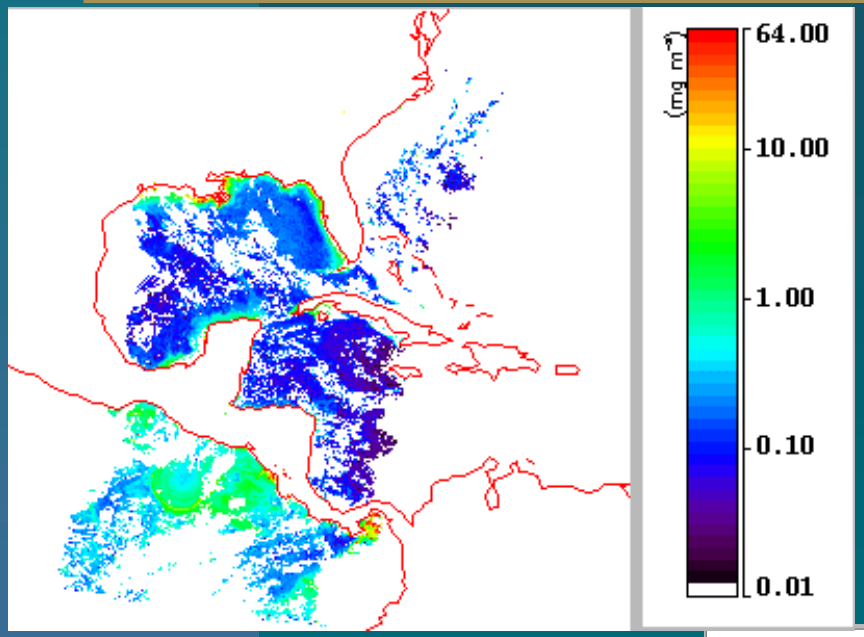


SEASONAL

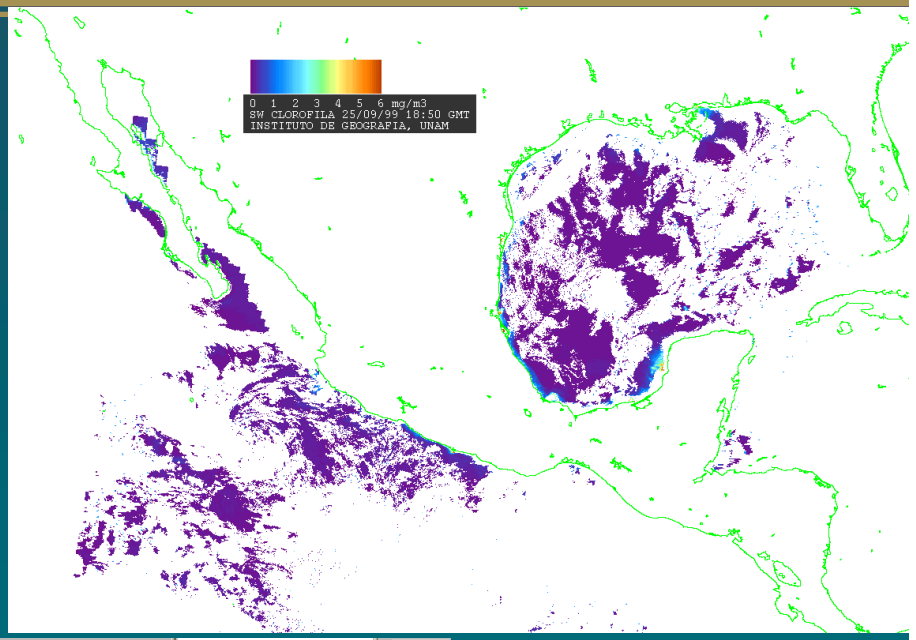
Normalized Difference Vegetation Index (NDVI)

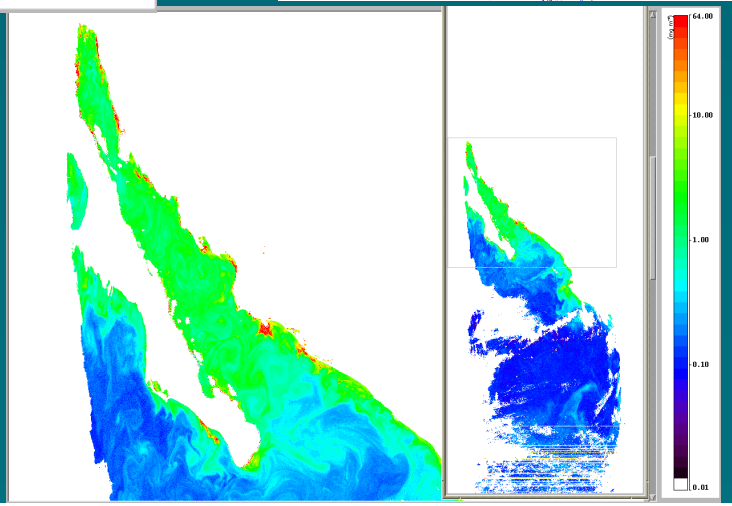


[Chl-a] Images



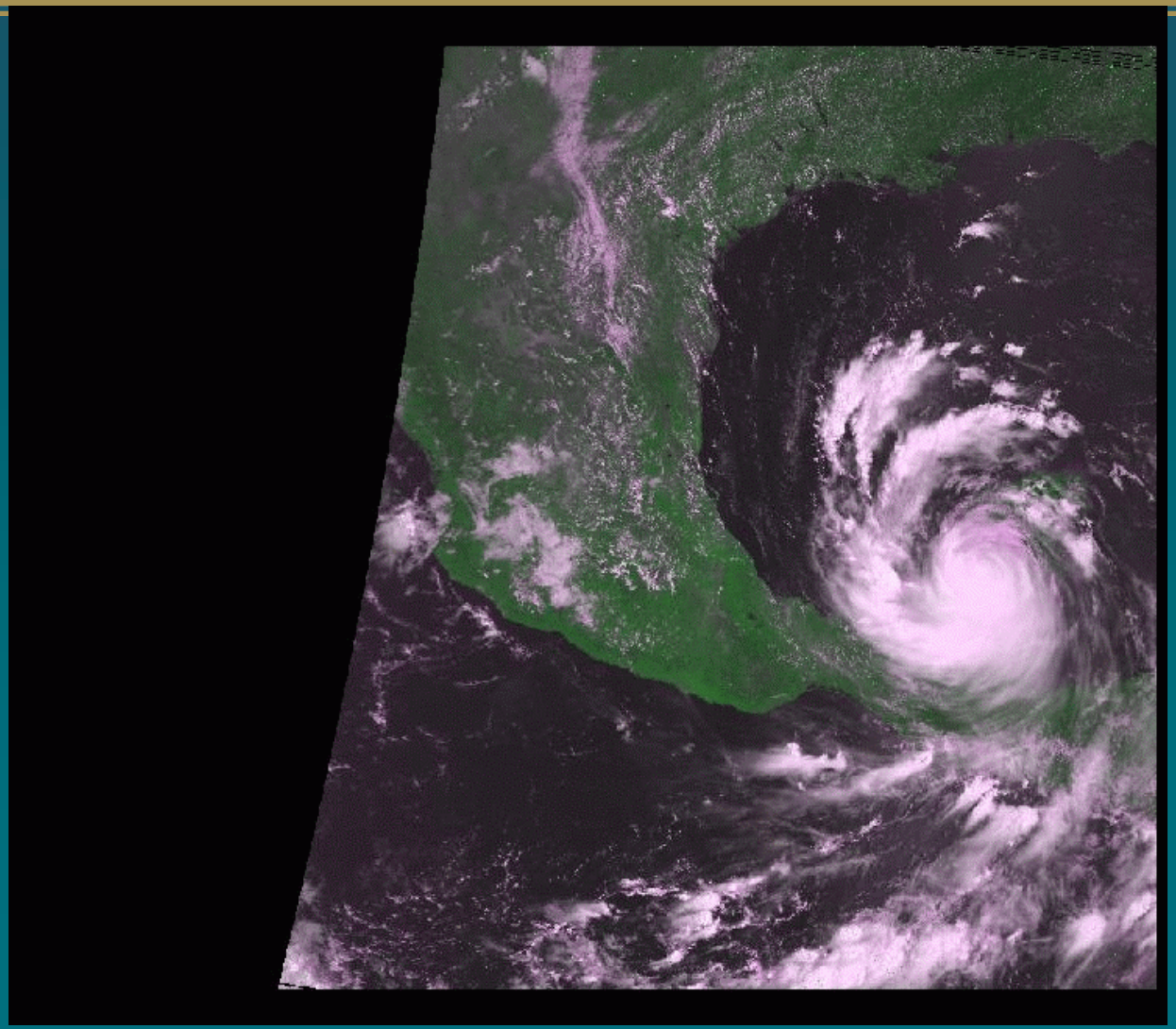
SeaDAS



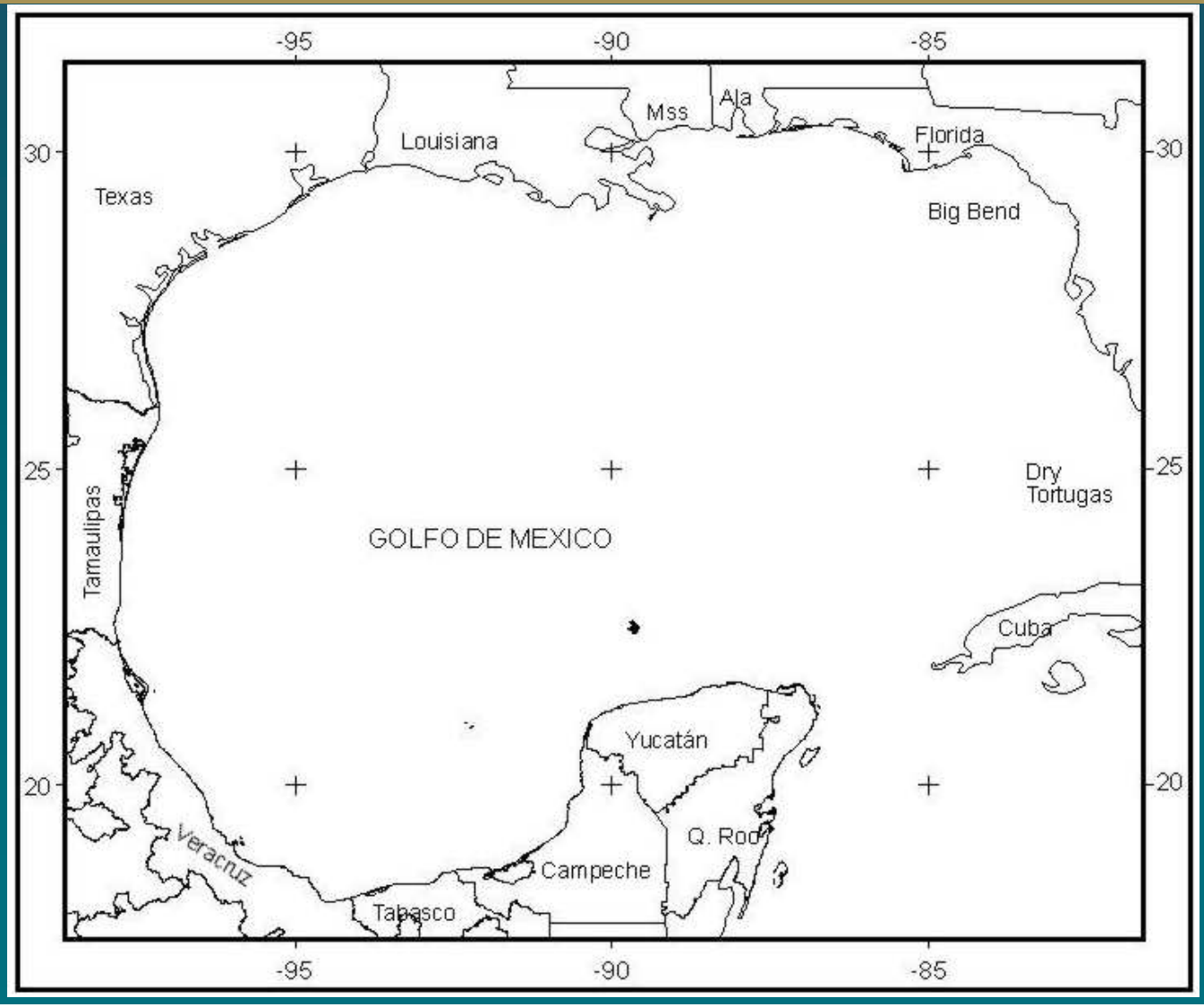


TeraScan

Hurricane “Dean”
21 August 2007



Study Area: Gulf of Mexico



Why regionalize the Gulf of Mexico (GM)?

- Mexico has an extensive litoral line both in the Pacific and in the Atlantic oceans: 11 592.77 km
- The Gulf of Mexico has 3117.71 km of litoral and 394 603 km^2 of continental shelf
- The GM is important by its natural resources such as fisheries, minerals, coral reefs, etc.
- The regionalization is fundamental to understanding and managing these resources

Why using SST and [Chl-a] images

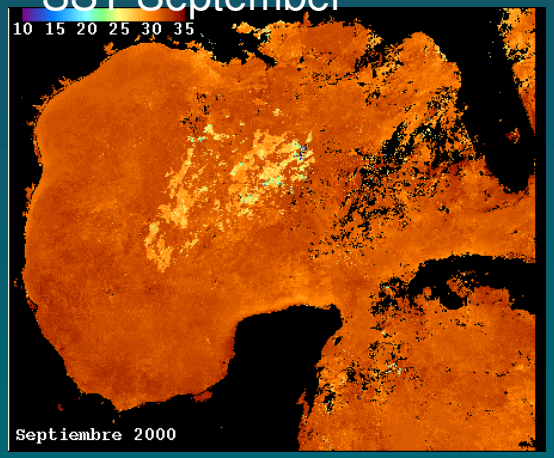
- SST plays and important role in the organisms lives ranging reproduction, nesting, feeding and growing stages
- [Chl-a] is and indicator of phytoplankton presence, the base of the food chain
- Understanding their dynamic allow us to detect a number of important fishery regions

Methodology

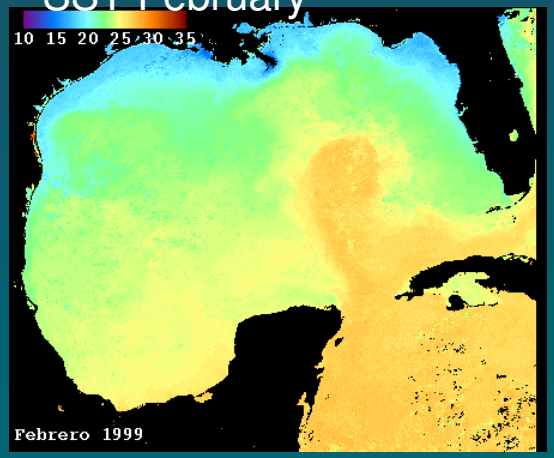
- SST and [Chl-a] imagery was used for generating:
- Monthly composites
- Anomalies
- EOF analysis
- Regionalization through EOF

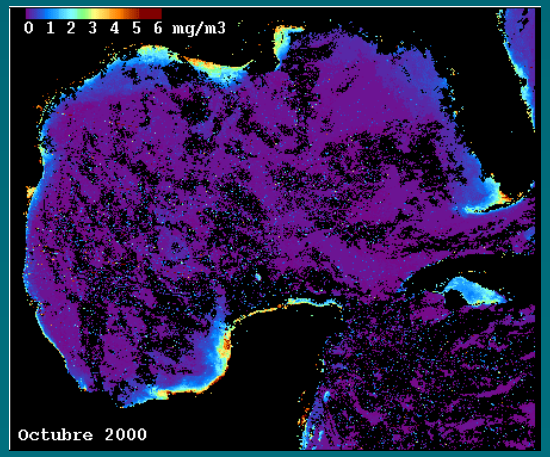
SST and [Chl-a] Monthly composites

SST September

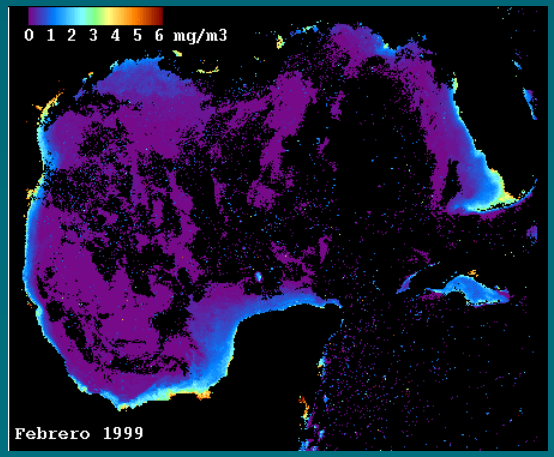


SST February





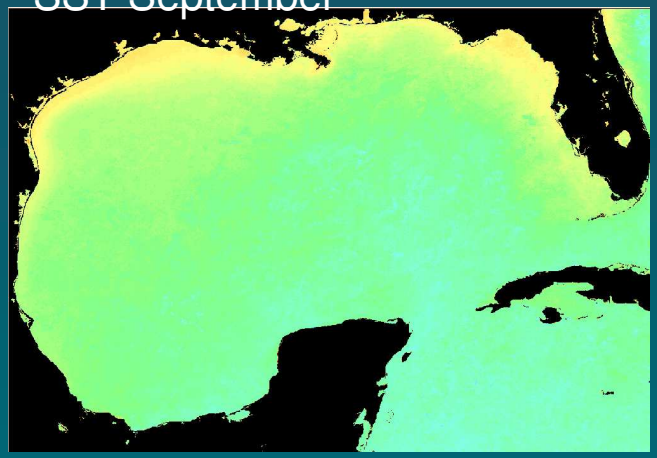
[Chl-a] October



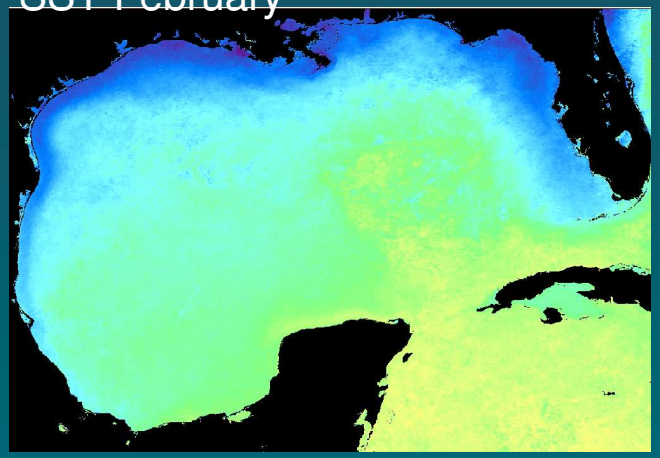
[Chl-a] February

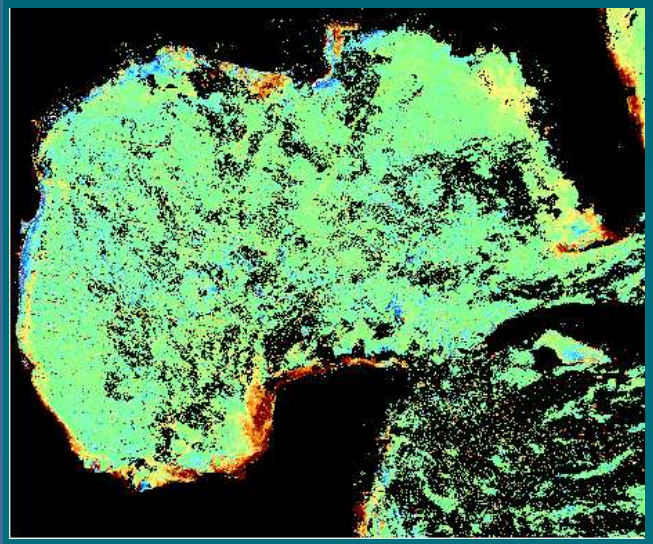
SST and [Chl-a] Anomalies

SST September

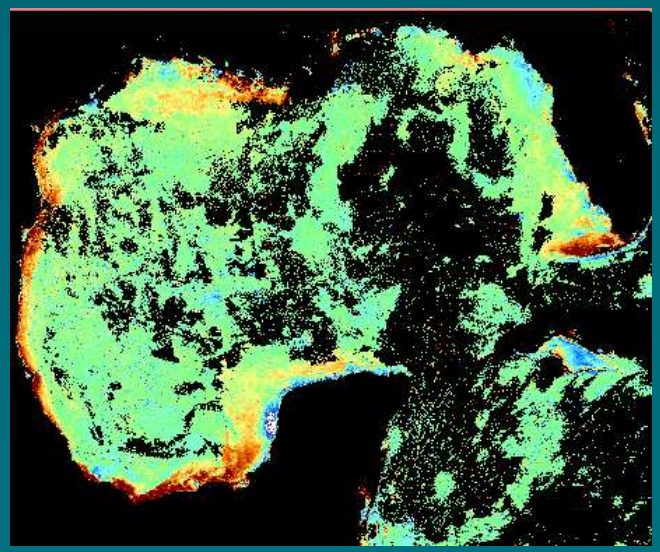


SST February



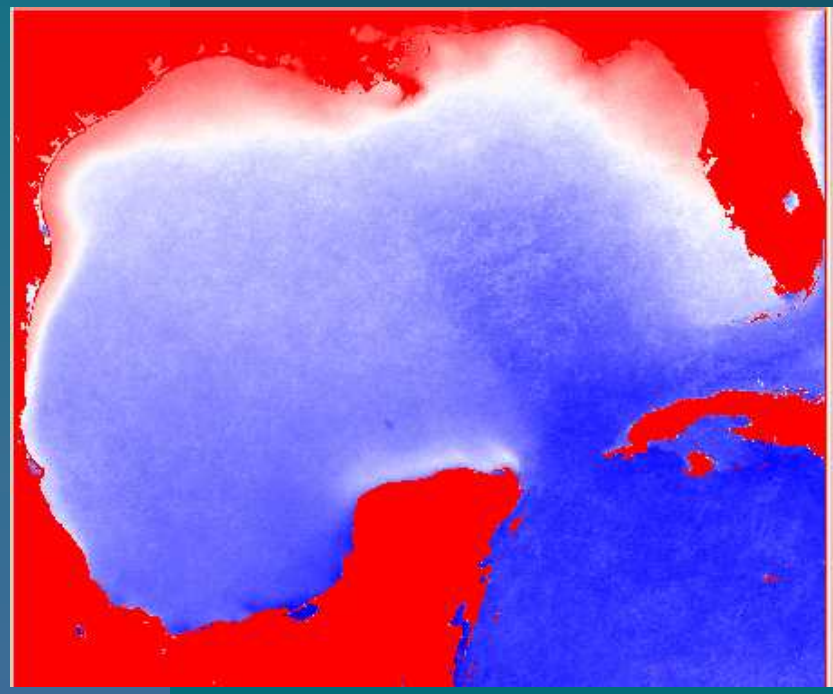


[Chl-a] October



[Chl-a] February

SST, EOF Analysis (modes 1 and 2)



Variance accounted for:

512.6553

=99.66436%

Variance accounted for:

1.220802

=0.2373338%

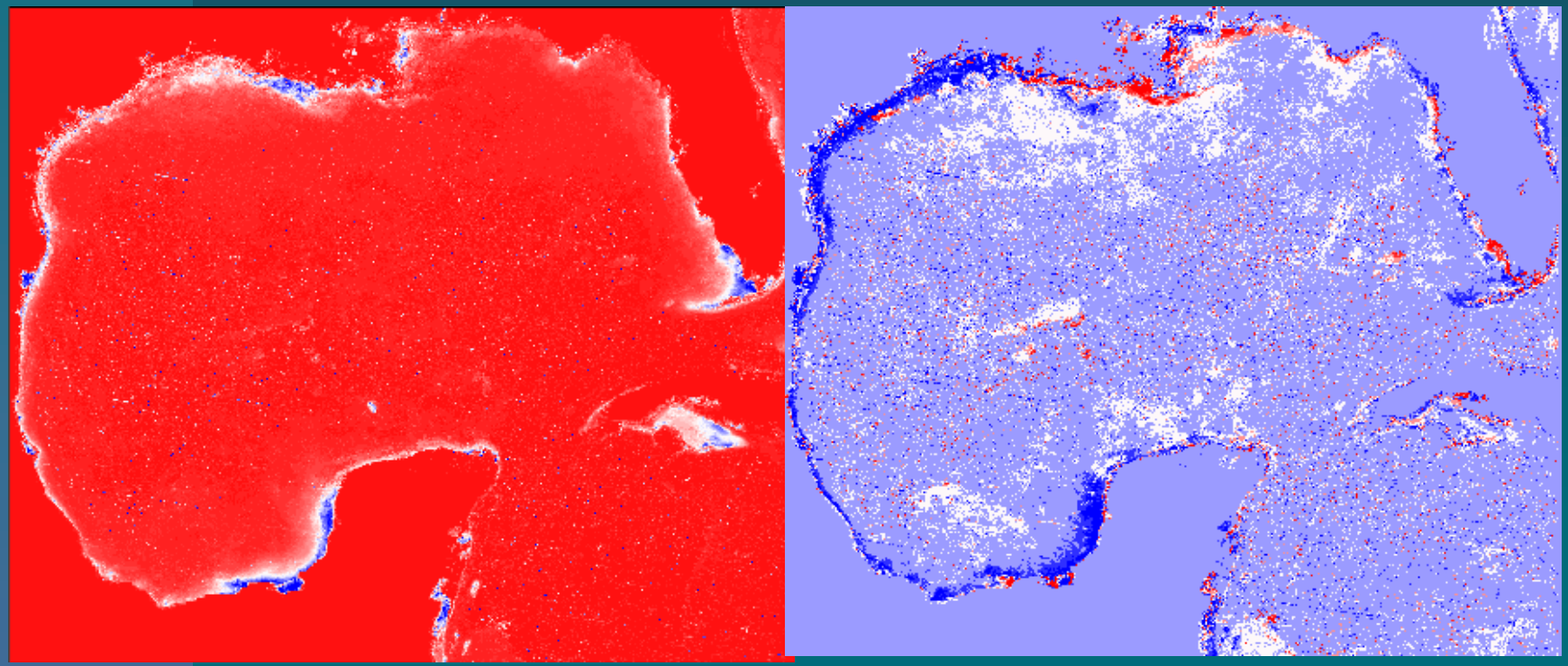
EOF SST

FEO/modes	%Variance accounted for by each Evalue
1	99.66436
2	0.2373338
3	0.02691482
4	0.02246972
5	0.01312593
6	0.01001597
7	0.00648593
8	0.0059026
9	0.00472312
10	0.00427759
11	0.0026886
12	0.00170211

Mcsst_MEAN_amp

Eigen values	Jan	Feb	Mach	April	May	June	July	Aug	Sept	Oct	Nov	Dic
Mode (EOF)	Coef 1	Coef 2	Coef 3	Coef 4	Coef 5	Coef 6	Coef 7	Coef 8	Coef 9	Coef 10	Coef 11	Coef 12
1	-0.876	1.476	-0.672	0.588	-0.343	0.942	-0.978	-0.913	1.968	0.042	-1.245	-0.202
2	-0.884	1.410	0.044	-0.338	-0.122	0.782	0.082	0.519	0.079	0.026	2.101	1.948
3	-0.906	1.039	0.405	-0.852	0.285	0.746	0.191	0.926	-0.375	-0.019	0.744	-2.643
4	-0.953	0.452	0.832	-1.319	0.718	0.170	0.704	1.054	-0.480	-0.355	-2.199	1.055
5	-1.00	-0.271	0.971	-1.517	0.962	-1.254	-1.022	-1.934	0.231	0.219	0.531	-0.009
6	-1.069	-1.064	-2.683	-1.443	-0.575	-0.131	0.237	0.186	0.036	0.006	0.052	-0.005
7	-1.102	-1.246	0.616	0.545	-0.679	1.142	-0.968	-0.247	-0.653	-2.314	0.100	0.037
8	-1.117	-1.159	0.663	0.486	-0.555	1.189	-0.426	0.028	-0.594	2.532	-0.224	0.131
9	-1.103	-0.938	0.895	0.499	-0.434	-0.619	2.060	0.183	1.940	-0.206	0.405	-0.182
10	-1.040	-0.261	-0.903	1.628	2.681	-0.151	0.045	0.262	-0.277	-0.043	0.159	0.017
11	-0.975	0.434	0.112	0.759	-1.015	-2.201	-1.408	1.539	-0.138	0.110	-0.117	-0.029
12	-0.916	1.145	-0.323	0.827	-0.917	-0.600	1.434	-1.619	-1.750	-0.047	-0.318	-0.124

[Chl-a], EOF Analysis (modes 1 and 2)



Variance accounted for ：

0.1149579=32.92523%

Variance accounted for ：

0.04064852=11.64219%

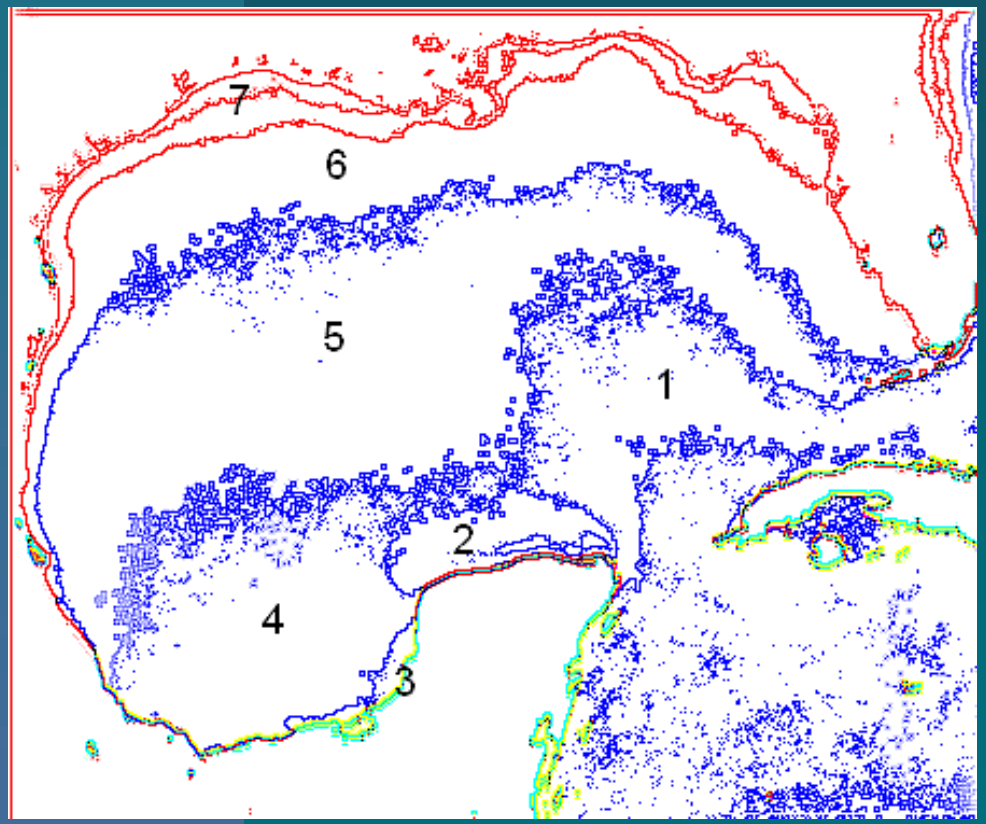
EOF [Chl-a]

EOF/modes	%Variance accounted for by each Evalue
1	32.92523
2	11.64219
3	10.74219
4	9.395965
5	8.133535
6	7.786484
7	7.463165
8	6.921774
9	4.989462
	99.999995

chlor_a_MEAN_amp

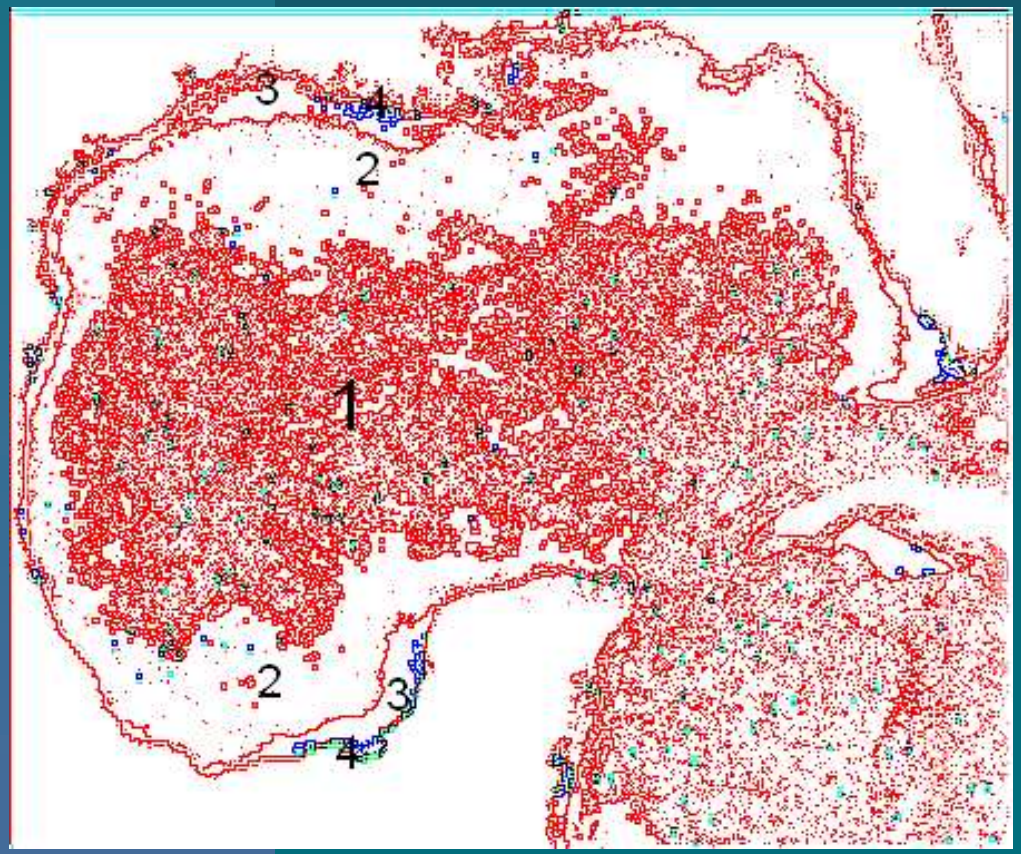
Eigenvalues	Feb	March	April	May	June	July	Sept	Oct	Nov
Mode (EOF)	Coef 1	Coef 2	Coef 3	Coef 4	Coef 5	Coef 6	Coef 7	Coef 8	Coef 9
1	-1.043	-0.332	-0.058	-0.245	-0.230	0.003	0.148	-0.327	2.748
2	-1.352	2.020	0.034	0.173	-0.679	0.699	1.393	-0.095	-0.397
3	-1.187	-0.777	-0.130	-1.922	-1.070	0.705	-0.803	0.723	-0.681
4	-0.860	-0.390	-0.065	-0.539	0.444	-2.392	1.156	0.649	-0.368
5	-1.072	1.287	0.063	0.350	0.703	-0.847	-2.201	-0.058	-0.047
6	-0.811	-0.413	0.037	-0.324	2.516	1.204	0.440	0.242	-0.172
7	-0.603	-0.607	-0.087	-0.292	-0.008	-0.234	0.065	-2.770	-0.664
8	-1.319	-1.349	-0.165	2.147	-0.553	0.262	-0.089	0.450	-0.464
9	-0.133	-0.186	2.989	0.004	-0.110	-0.019	0.015	-0.017	-0.021

SST regions



- 1: Loop Current
- 2: Yucatán Upwelling
- 3: Rivers discharges
- 4: South of GM
- 5: Deep ocean
- 6: Northern Outer shelf
- 7: Northern Inner shelf

[Chl-a] regions



- 1: Deep ocean
- 2: Outer shelf
- 3: Inner shelf
- 4: River discharges

Conclusions

- The EOF analysis allows us to detect and to enhance concealed information
- SST spatial variations showed 7 regions zonally (latitudinal) arranged, while [Chl-a] variations recognized only 4 regions around the GM coasts. There are not relationship between two parameters.
- Fishing catching zones have a closer relationship to [Chl-a] regions than to SST regions

IG
INSTITUTO DE GEOGRAFÍA
U N A M

THANKS