Edge (Front) Detection

- Please see *Course*\4\ *Exercises_WAM_Edge_detection.pdf*
- The location of fronts in the sea-surface temperature (SST) images provides information on a variety of processes in the ocean. Automated objective methods to detect SST fronts have been in the development for many years. Typical edge-detection methods such as the Sobel operator are discrete approximations to the gradient. Gradient-based edge detectors are characterized by spurious responses when applied to noisy data. These so-called local operators use a threshold to distinguish an edge from "normal" variability. Gradient operators are known to be hard to use with not ideal data (Holyer and Peckinpaugh, 1989). Among the several more advanced methods the single-image edge detection (SIED) method of Cayula and Cornillon (1992) has been shown to be superior in tests (Cayula et al., 1991).

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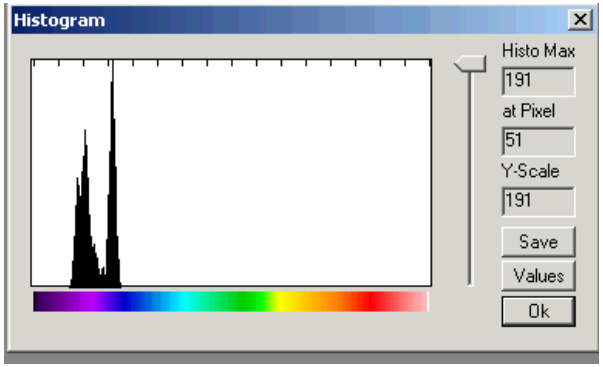
- The basic idea of the SIED method is to use overlapping windows to investigate the statistical likelihood of an edge by (1) performing a histogram analysis to detect bimodality of the histogram and (2) detecting the cohesiveness of the potential edge. A modification to the SIED method proposed by Diehl et al (2002) uses variogram analysis in two directions to find the best window size in x and y directions instead of a fixed window size.
- The SIED method has been implemented in WIM and WAM. You can create edge (front) images interactively with WIM.
- Batch processing is implemented in WAM programs *wam_edge and wam_edge_accumulate.*

Frequency of SST fronts

SST fronts are known to be areas where fish congregate

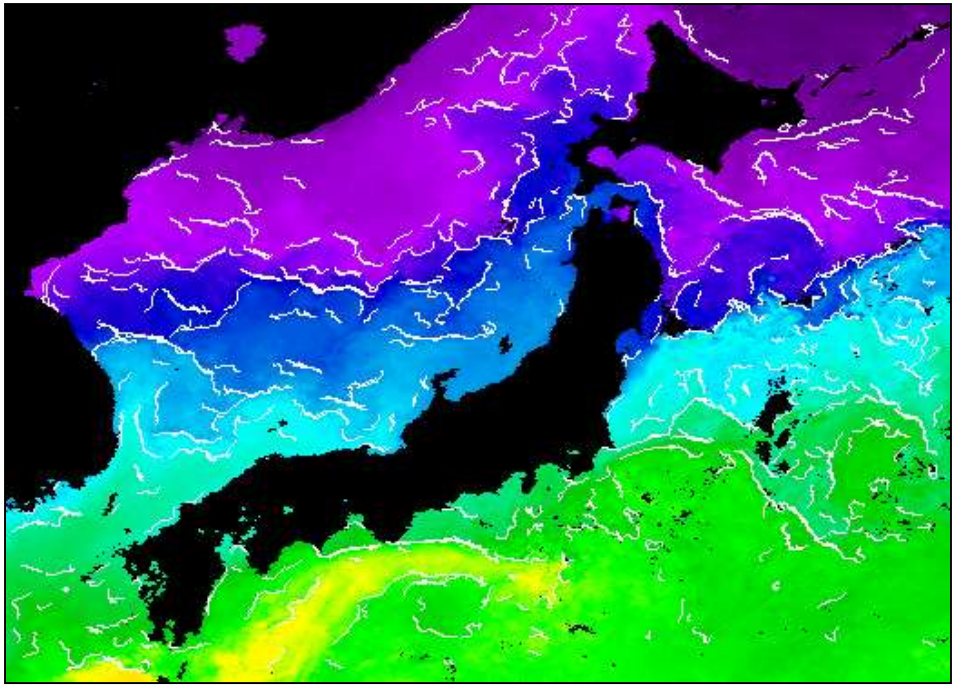
Frequency of SST fronts may affect fish recruitment and/or primary production

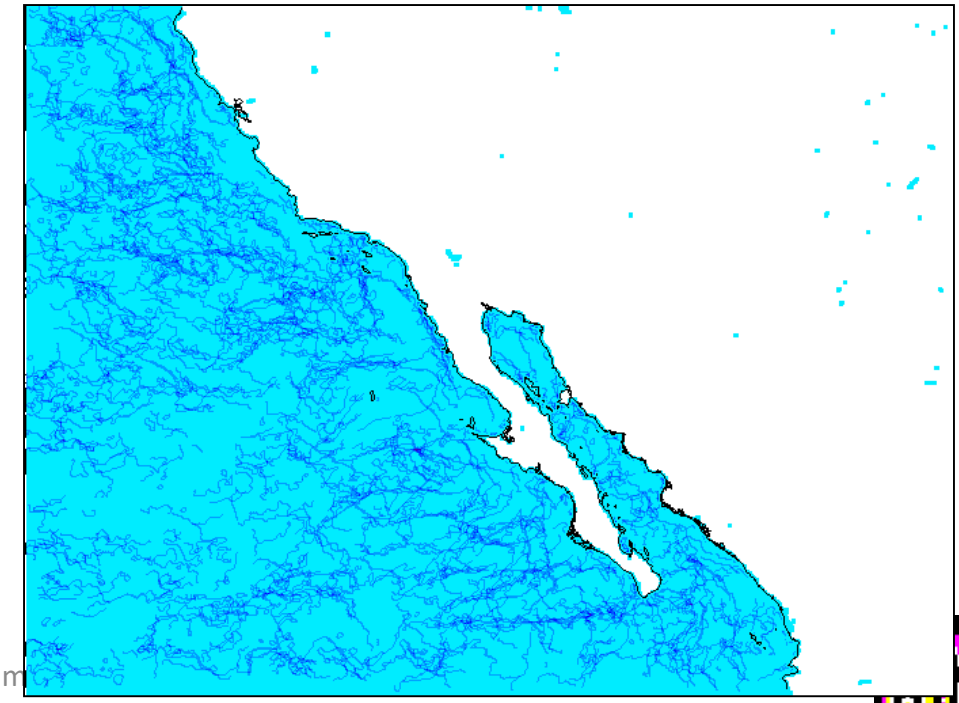
Using the Cayula-Cornillon (CC) method of edge detection



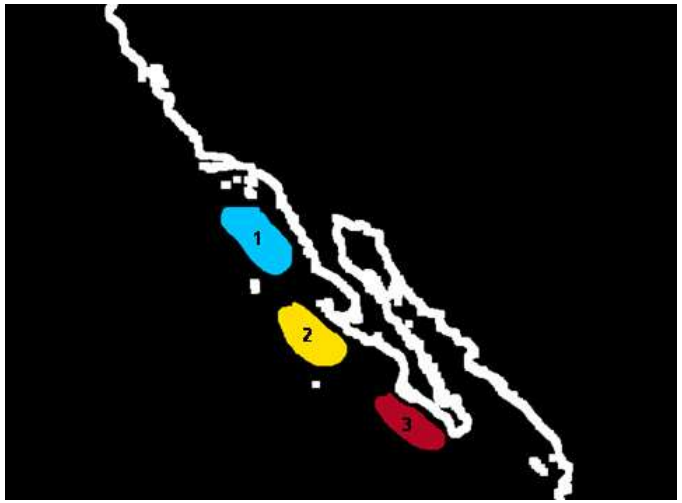
Single edge image -> accumulated edge image (=>Front Frequency) with edge statistics (normalized per valid pixels)

Front Frequency off California



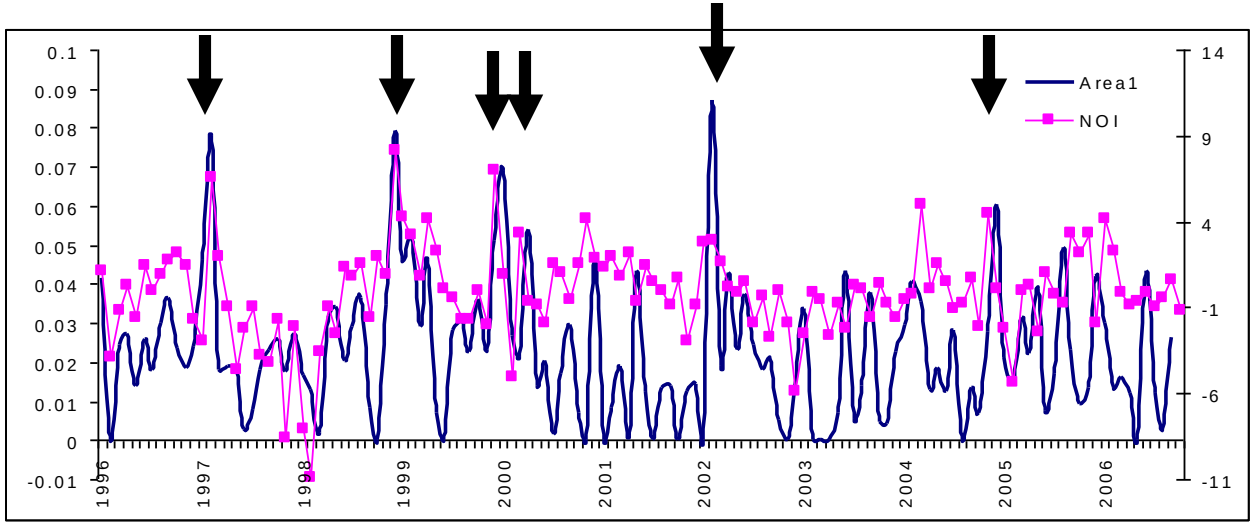


Frequency of SST fronts (with M. Manzano, CIBNOR, Mexico)



Front Frequency (FF) seems to be correlated with long-term processes, e.g. ENSO (NOI = Northern Oscillation Index)

Area 1



Area 1 = Southern California Bight

NOI = Northern Oscillation Index is an index of climate variability based on the difference in SLP anomalies at the North Pacific High and near Darwin Australia

Edge detection…

- Sample SST files, MODIS-Aqua 4-km subsampled (cut) for the Kuroshio area:
  \Images\MODISA\L3\Monthly\SST_4_kur
- Try various edge detection methods in WIM, e.g.
  - *Transf-Gradients-Sobel*
  - *Edge-Shade Edge*
  - *Edge-SIED* with variable and larger (20) window
- WAM has commands for edge detection and compositing in batch mode

Edge detection…

cd C:\Sat\MODISA\L3\Monthly

wam_edge (to see the syntax!)

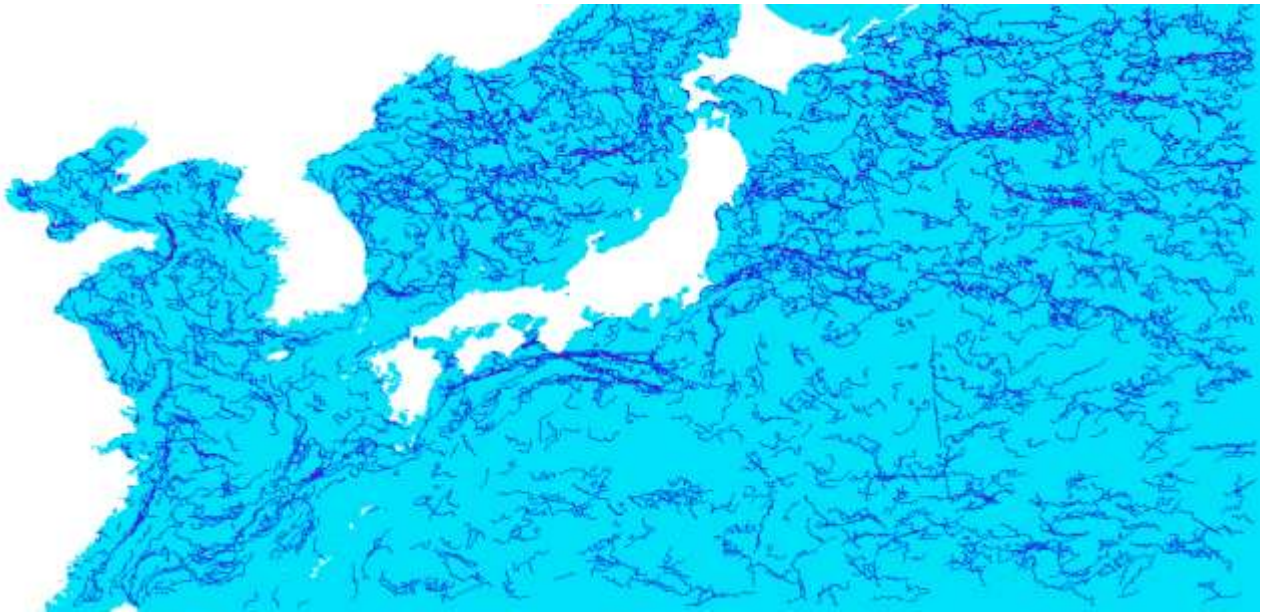
wam_edge SST_4_kur*.hdf window=20 landmask=landmask.hdf

mkdir sst_fronts

move A*sied*.* sst_fronts

move sst_fronts\A*sied_20.hdf SST_4_kur

wam_edge_accumulate SST_4_kur\A*_cut.hdf A



← Front frequency