Automated Method to Track Persistent SST Fronts

Yackar Mauzole (yackar_mauzole@my.uri.edu)
Peter Cornillon (pcornillon@uri.edu)
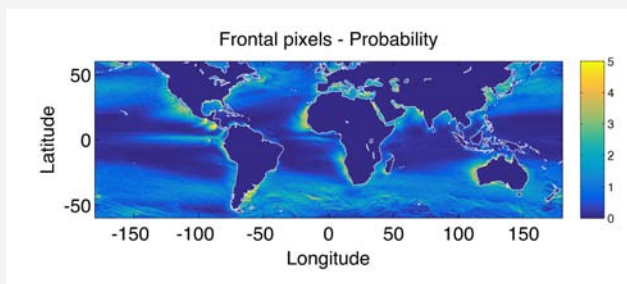
Graduate School of Oceanography, University of Rhode Island, Narragansett, RI

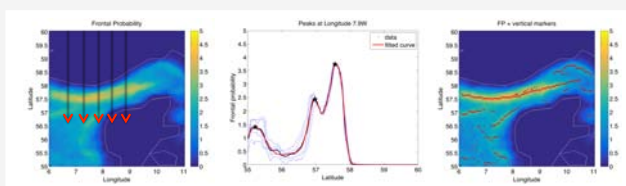THE UNIVERSITY OF RHODE ISLAND GRADUATE SCHOOL OF OCEANOGRAPHY

Introduction:

Frontal regions are typically located subjectively, leading to inconsistency in their location. The objective of this study is to develop an automated method to locate persistent SST frontal regions.

Dataset and methods:

The location of SST frontal pixels is determined from the 4km resolution NOAA/NASA AVHRR Pathfinder SST dataset using the Cayula-Cornillon front detection algorithm. Front probability is defined as the number of times during the period of interest (1982-2011 in this case) that a given pixel is identified as a frontal pixel divided by the number of times the pixel was flagged as clear.
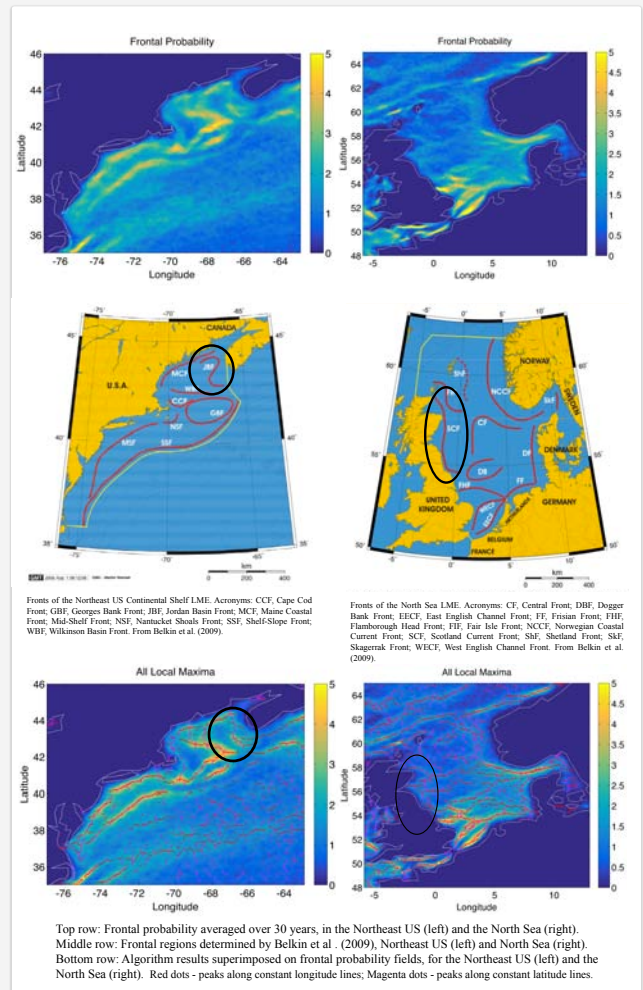

The location of SST frontal **regions** is determined by locating ridges in the probability field. This is done by locating peaks with a Gaussian fitting routine first along each line of constant longitude in a 121x121 pixels window (5°x5°), and then along each line of constant latitude in the same window. In order to reduce the effects of noise, the lines were averaged in groups of five prior to fitting the Gaussian curves to the data. The process is repeated for all 121x121 pixel windows in the image with the center of frontal regions being identified as the peaks of the located Gaussian curves.

Results:

Fronts of the Northeast US Continental Shelf LME. Acronyms: CCF, Cape Cod Front; GBF, Georges Bank Front; JBF, Jordan Basin Front; MCF, Maine Coastal Front; Mid-Shelf Front; NSF, Nantucket Shoals Front; SSF, Shelf-Slope Front; WBF, Wilkinson Basin Front. From Belkin et al. (2009).

Fronts of the North Sea LME. Acronyms: CF, Central Front; DBF, Dogger Bank Front; EECF, East English Channel Front; FF, Frisian Front; FHF, Flamborough Head Front; FIF, Fair Isle Front; NCCF, Norwegian Coastal Current Front; SCF, Scotland Current Front; ShF, Shetland Front; SkF, Skagerrak Front; WECF, West English Channel Front. From Belkin et al. (2009).

Top row: Frontal probability averaged over 30 years, in the Northeast US (left) and the North Sea (right). Middle row: Frontal regions determined by Belkin et al . (2009), Northeast US (left) and North Sea (right). Bottom row: Algorithm results superimposed on frontal probability fields, for the Northeast US (left) and the North Sea (right). Red dots - peaks along constant longitude lines; Magenta dots - peaks along constant latitude lines.

The advantage of automated detection is seen in the above comparisons between fronts identified subjectively by Belkin et al. (2009) and those identified objectively here. There is general agreement but, as they say, 'the devil is in the details' - consider the encircled regions in the above figures.

Conclusions:

• The algorithm appears to do a good job of locating persistent fronts.
• The approach scales while the subjective location of fronts does not. The algorithm can be used to examine:
 • The interannual variability of frontal locations
 • The seasonal variability, etc…

References:

Cayula J-F. and Cornillon P.C., 1995: Multi-image detection for SST images, in Journal of Atmospheric and Oceanic Technology, 12, pp 821-829
Belkin I.M. and Cornillon P.C., 2007: Fronts in the World Ocean's Large Marine Ecosystems, from the International Council for the Exploration of the Sea, D:21
Belkin I.M., Cornillon P.C. and Sherman K., 2009: Fronts in Large Marine Ecosystems, in Progress in Oceanography, 81, pp 223-236

Acknowledgements: