Mesoscale variability along the east coast of India in spring and fall revealed in satellite data and OGCM

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1. Introduction
2. General circulation
3. Analysis for spring (Satellite and OGCM)
4. Analysis for fall (Satellite and OGCM)
5. Summary of the results
1. Introduction: India's population growth and fisheries!!!

**Population growth for India & China**
UN Population prospects (2006)

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>China</th>
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<tbody>
<tr>
<td>2000</td>
<td>1,000</td>
<td>1,100</td>
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<tr>
<td>2010</td>
<td>1,100</td>
<td>1,200</td>
</tr>
<tr>
<td>2020</td>
<td>1,200</td>
<td>1,300</td>
</tr>
<tr>
<td>2030</td>
<td>1,300</td>
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<td>2040</td>
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<td>1,500</td>
</tr>
<tr>
<td>2050</td>
<td>1,500</td>
<td>1,600</td>
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</table>

**Fish catchment by India**

Drastic increase in the last two decades

**Geographic information**
(Motivation of this study)
- Total Area: 3.2 million km²
- Exclusive Economic Zone (EEZ): 2.02 million km²
- Population (in 2004): 1.1 billion

So ‘fisheries’ is very important for India.
2. Uniqueness of Indian coast: Influence of the seasonal winds ‘the monsoon’

Winter monsoon (DJF)

Wind (in Pa)    Currents (in ms$^{-1}$)

EICC : East India Coastal Current
2. Uniqueness of Indian coast: Influence of the seasonal winds ‘the monsoon’

Summer monsoon (JJA)

Wind (in Pa)  Current (in ms⁻¹)

EICC : East India Coastal Current
2. Importance of inter-monsoon periods: Spring (MAM) & fall (SON)

Longitude-Time plot (15˚N)
wind stress curl (X10^6 Pam^-1)

Longitude-Time plot (15˚N)
(150m) density anomaly (Kgm^-3)

Wind stress curl $\rightarrow$ Ekman pumping $\rightarrow$ Western boundary currents.
Wind stress curl enhances EICC than the monsoon driven coastal currents.
Availability of satellite data under relatively clear sky.

- Cold water locations are identified as Meanders in SST.
- Productive regions matches with cold water locations.
- Meanders are present in the geostrophic velocity pattern.
  - Northern meander \( \rightarrow \) an eddy within \( \sim 1 \) month.
- The meanders moved downstream \( \rightarrow \) Baroclinic instability.
3. Mesoscale variability in spring from OGCM

Temperature at 150m

First stage: the EICC formed due to Rossby waves
Second stage: meanders due to instability
Third stage: meanders fully developed and reached equilibrium, downstream propagation

=> Let’s look at potential vorticity and energy transfer
3. OGCM suggests baroclinic instability in **spring**

1. **Potential Energy** (April 15)
2. **Temperature**
   - 150m
   - 450m
3. **Meridional gradient of Potential vorticity**
4. **Potential to Kinetic energy transfer**

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**1. Excess potential energy along the coast for liberation.**

**2. Phase shift between upper & lower layer temperature**

**baroclinic instability.**

**3. Necessary condition for baroclinic instability is satisfied.**

**4. Extraction of available potential energy from the mean flow is shown.**
4. Satellite data analysis for fall, 2003

Difficult to identify meanders from SST.

Chl-a maxima along coastal strip.

The southward narrow EICC Weak mesoscale meanders
4. Mesoscale variability in fall from OGCM

Narrow southward EICC was reproduced with weak mesoscale variability

Velocity at 90m

Temperature at 90

Oct 27
5. General summary for EICC mesoscale variability in Spring and fall inter-monsoon

**Spring**: Active mesoscale variability. OGCM showed ‘baroclinic instability’. It helped fisheries nourishment prior to the upwelling favored summer monsoon winds.

Either satellite data or OGCM did not show pinching off of eddies. Indicates weak instability compared to the Kuroshio or Gulf Stream.

Linear stability model and a local QG model (Ikeda, 1981) supported the OGCM results.

**Fall**: Weak mesoscale variability. The linear stability model and the local model suggested that baroclinic instability is not possible. But the local model suggested ‘barotropic instability’. It might help to enhance the productivity along the coastal belt.
Note of thanks……..

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Thank you very much for your kind attention

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