Internal tides in the Solomon Sea

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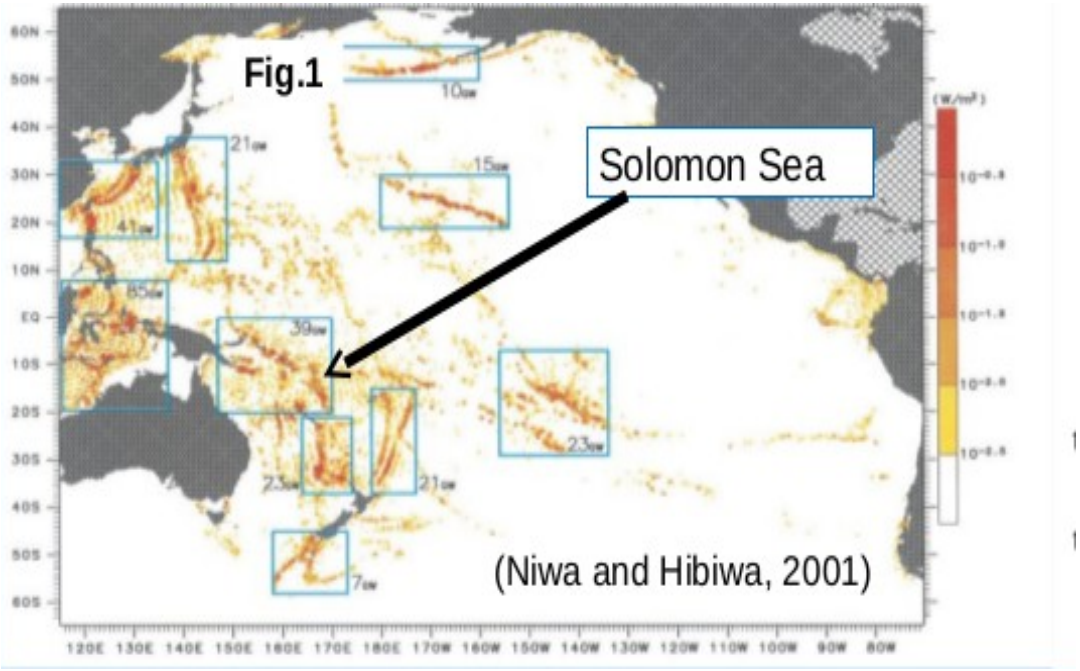
Introduction



The Solomon archipelago is one of the most efficient place for the generation of M2 internal tides

Water mass transformation (mixing) : eddies, western boundaries current, internal tides

Primary result on M2 internal tides in the Solomon sea

The model : 1/36° Solomon sea with tides

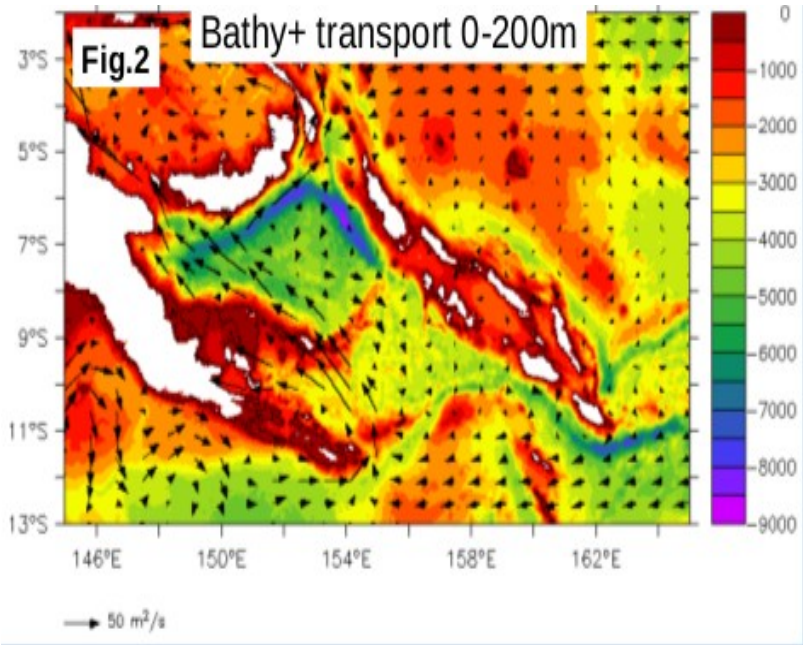
1/36° horizontal grid, **75 vertical levels** ; partial step; partial slip boundary condition, time splitting

Bathymetry: GEBCO08; Interannual forcing: DFS5.2 (1992-2000)

Tidal forcing at the open boundary: nine major constituents from FES2014

Open boundary condition: DRAKKAR 1/12° model

Initialization: The 1/36° regional model without tide (Djath et al., 2014)



1h snapshots (January to March 1998)

barotropic and baroclinic harmonic amplitudes and phases after projection onto the 10 first vertical modes

Results : M2 barotropic tide

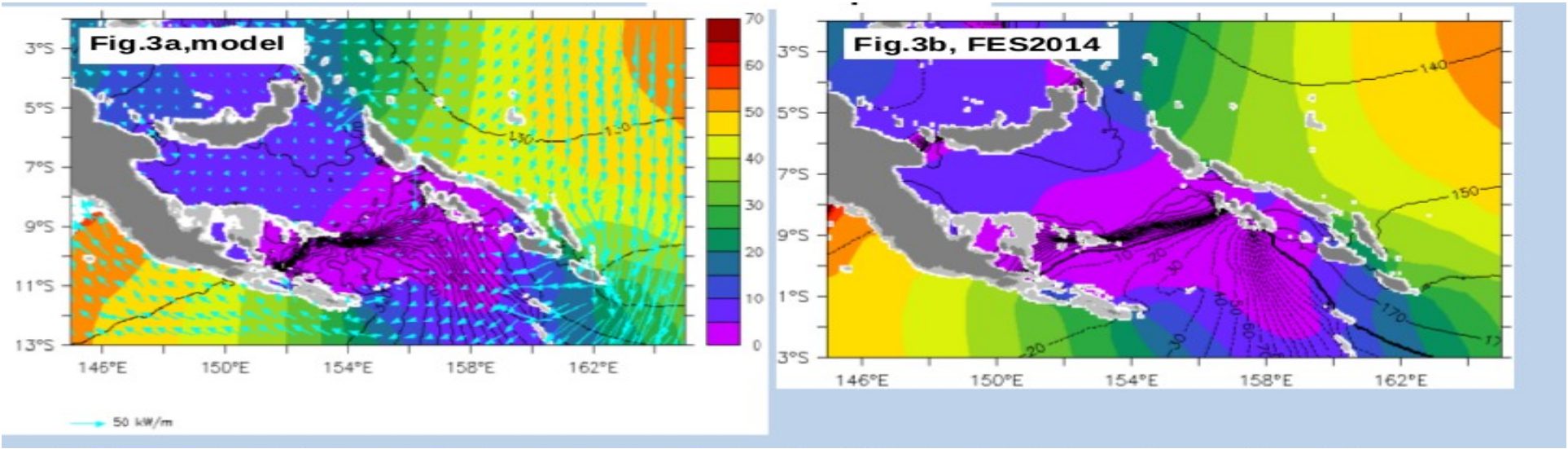


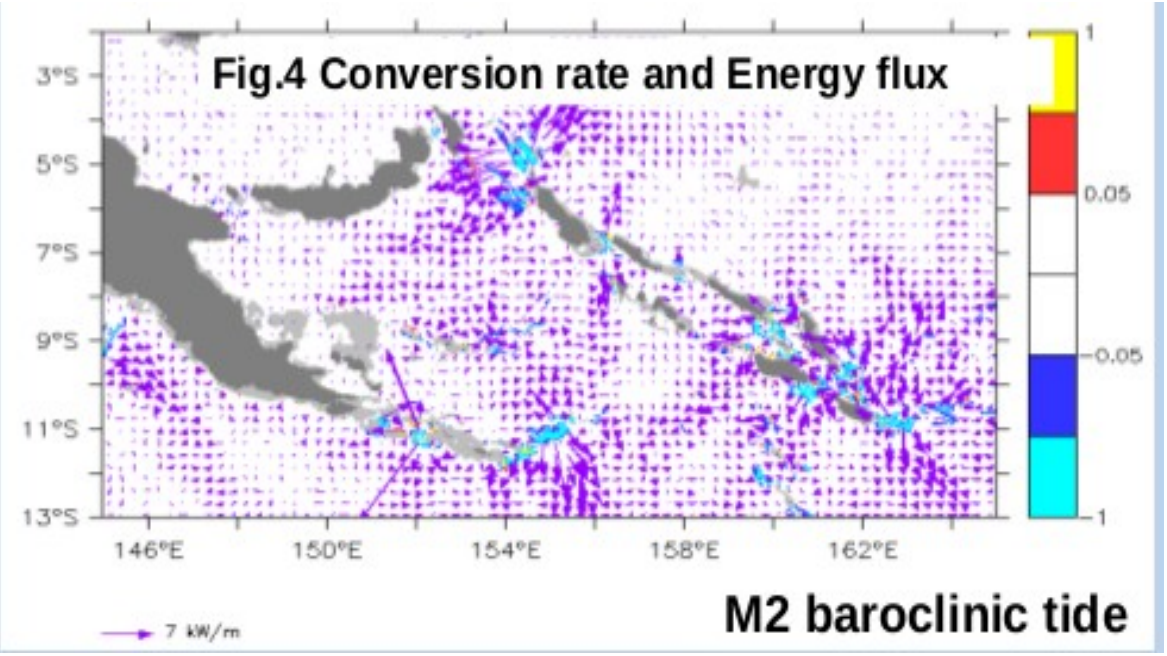
Figure 3: Amplitude (cm, shading) and phase (contours) of the M2 barotropic tide from a) the model and b)FES2014. The M2 bartropic energy flux is superimposed (vectors)

Tidal forcing well simulated by the model

- ✔ M2 barotropic tide is very low
- ✔ Barotropic energy flux is southward east of the Solomon Sea and turns westward
- ✔ No flux enters the Solomon Sea

Results : M2 baroclinic (internal) tides

Generation of M2 internal tides : **conversion rate from the barotropic to baroclinic tides**



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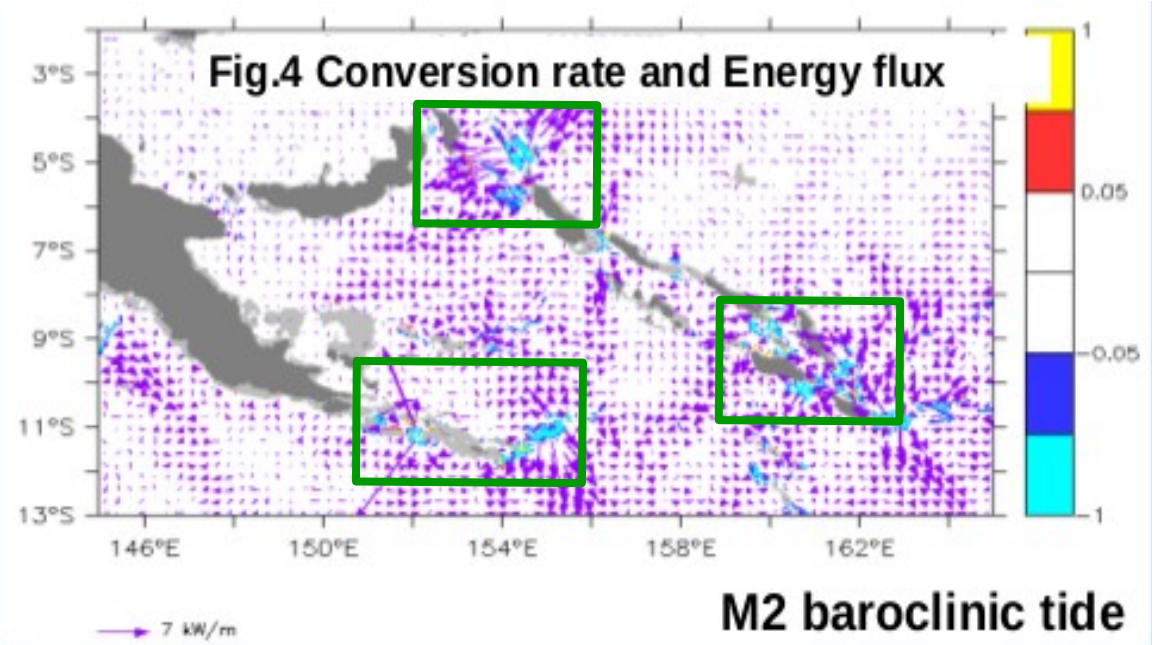
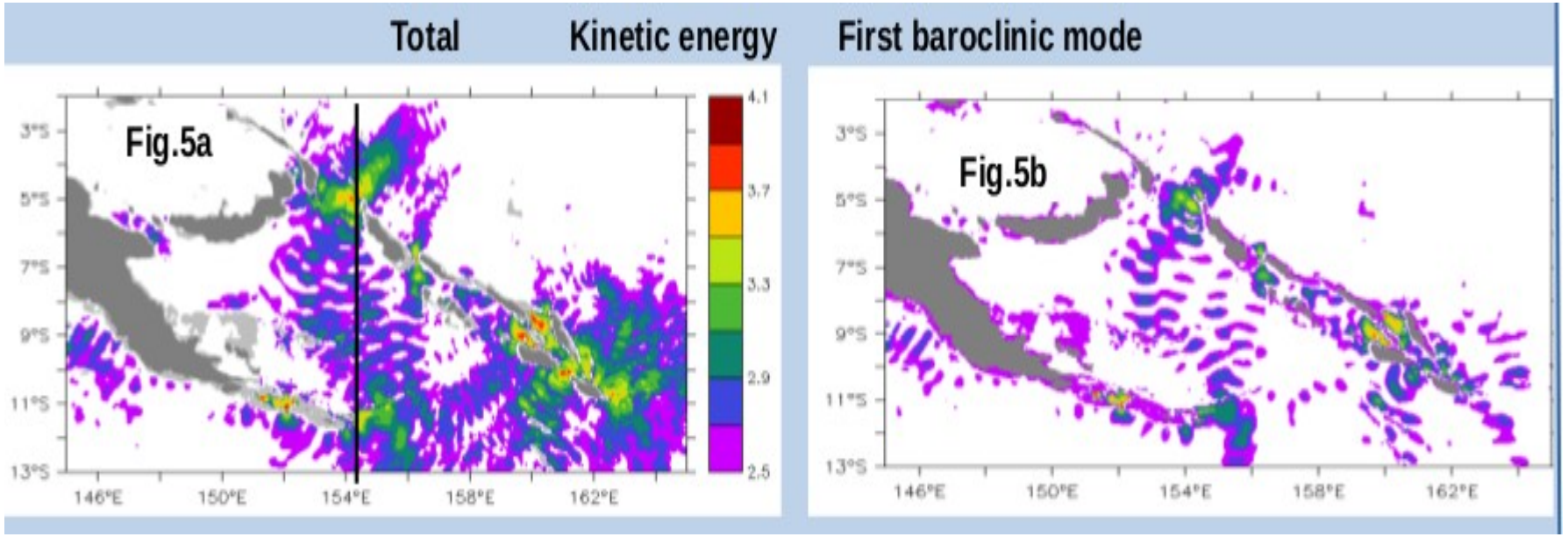


Three zones emerge: two at the north and south extremity of the Solomon archipelago and one at the southeastern extremity of the PNG peninsula.

M2 baroclinic energy flux radiates inside and outside the Solomon Sea.

Results : M2 baroclinic (internal) tides

M2 baroclinic: **Kinetic energy**



- ✔ Energy extends along the central Solomon sea from the production zones
- ✔ Energy dissipates locally
- ✔ Dominance of the first baroclinic mode

Results : M2 baroclinic (internal) tides

Vertical View

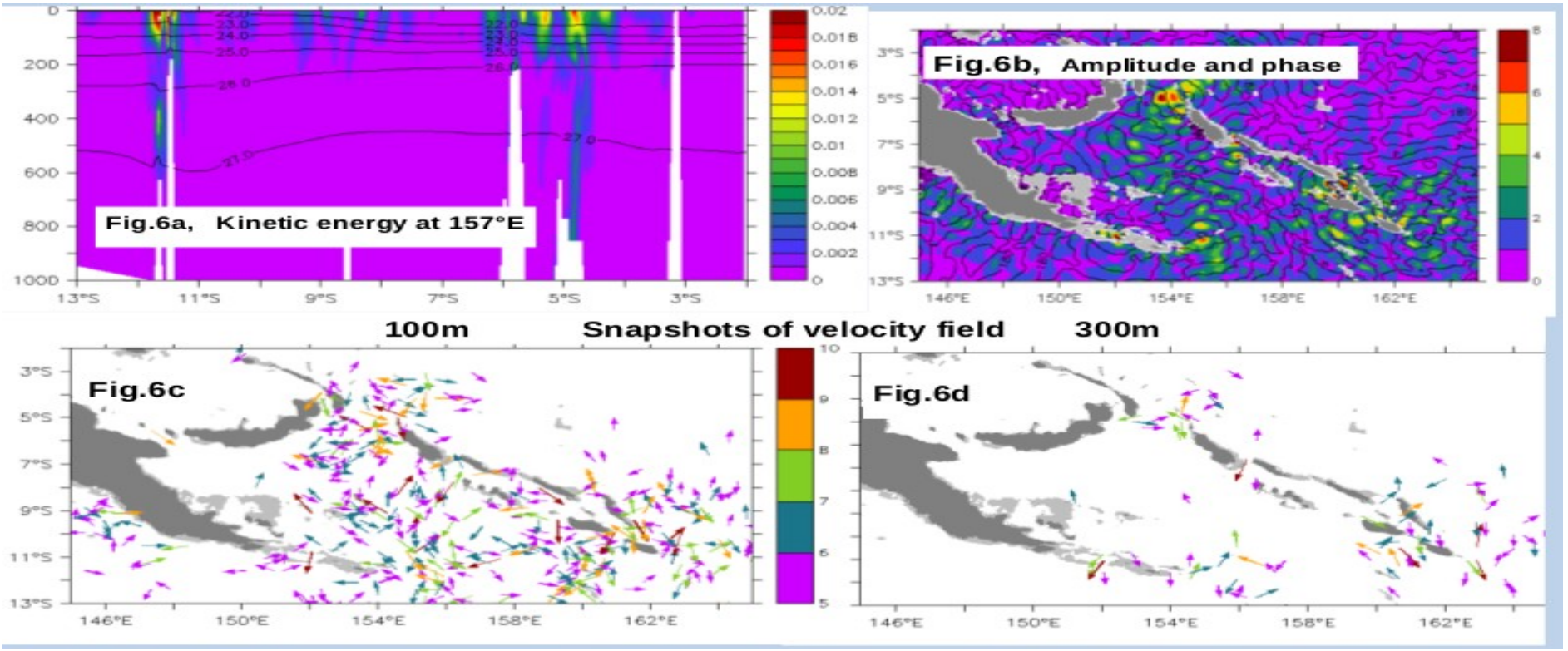


Figure 6:a) Depth/latitude section at 157°E of M2 baroclinic kinetic energy (J m -3). b) Snaphots of the horizontal velocity field at a) 100 m depth and b) 300 m depth for the M2 baroclinic tides (cm s -1). c) Amplitude (shading, cm) and d) phase(contour of the 180° phase) of the M2 baroclinic tide at the surface

- ✔ Energy concentrated at the surface layers : No propagation to the bottom
- ✔ No signature of the internal tides below 300 Km, except in the generation zones
- ✔ At the surface, internal tides amplitude is about 4-5 cm, 8 cm for generation zones

Results :Water mass transformation

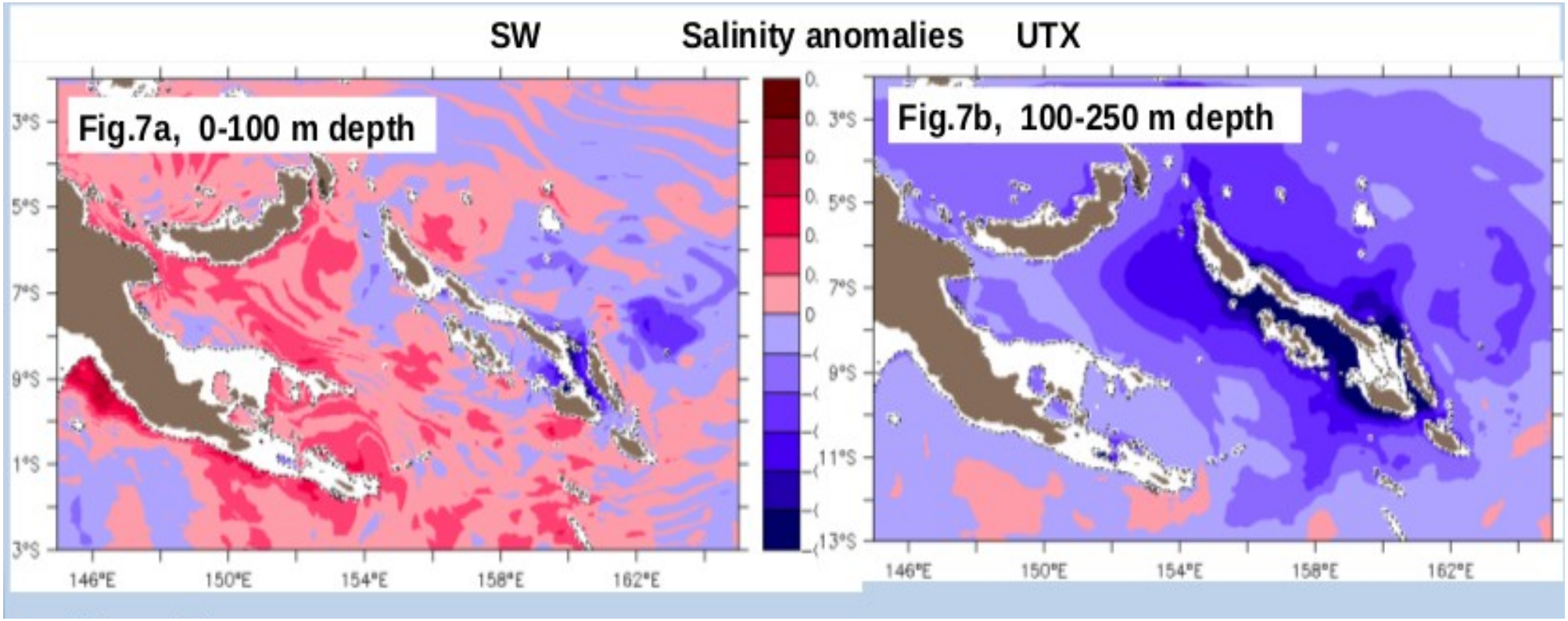


Figure 7: Salinity anomalies between the model with and without tidal forcing for a) the Surface Waters (SW, 21-23.3 sigma) and b) the Upper Thermocline Waters (UTW, 23.3-25.7 sigma).

Positive SW and negative UTW anomalies argue for diapycnal mixing by tides

Conclusion

The model simulate well the tidal forçing.

Internal tides are generated at the extremities of the Solomon archipelago and of the PNG peninsula.

They propagate in the Solomon Sea with a 4-5 cm amplitude.

The next step is to quantify the impact of such tides on water mass transformation