

Development of a Fine-Scale (1/648°) Nested Ocean Forecasting Model of the Tunisian Shelf

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Resolving ~100 m submesoscale processes fundamentally changes coastal transport predictions compared to km-scale models.

1. CONTEXT & METHODS

Why High-Resolution Modeling Matters?

The Tunisian shelf exhibits strong mesoscale and submesoscale variability. Complex bathymetry, tidal forcing, and intense air-sea interactions (storms) → impacts chlorophyll-a blooms → Standard models (1–5 km) fail to resolve 100 m–1 km processes. → Missing physics → inaccurate transport and ecosystem representation.

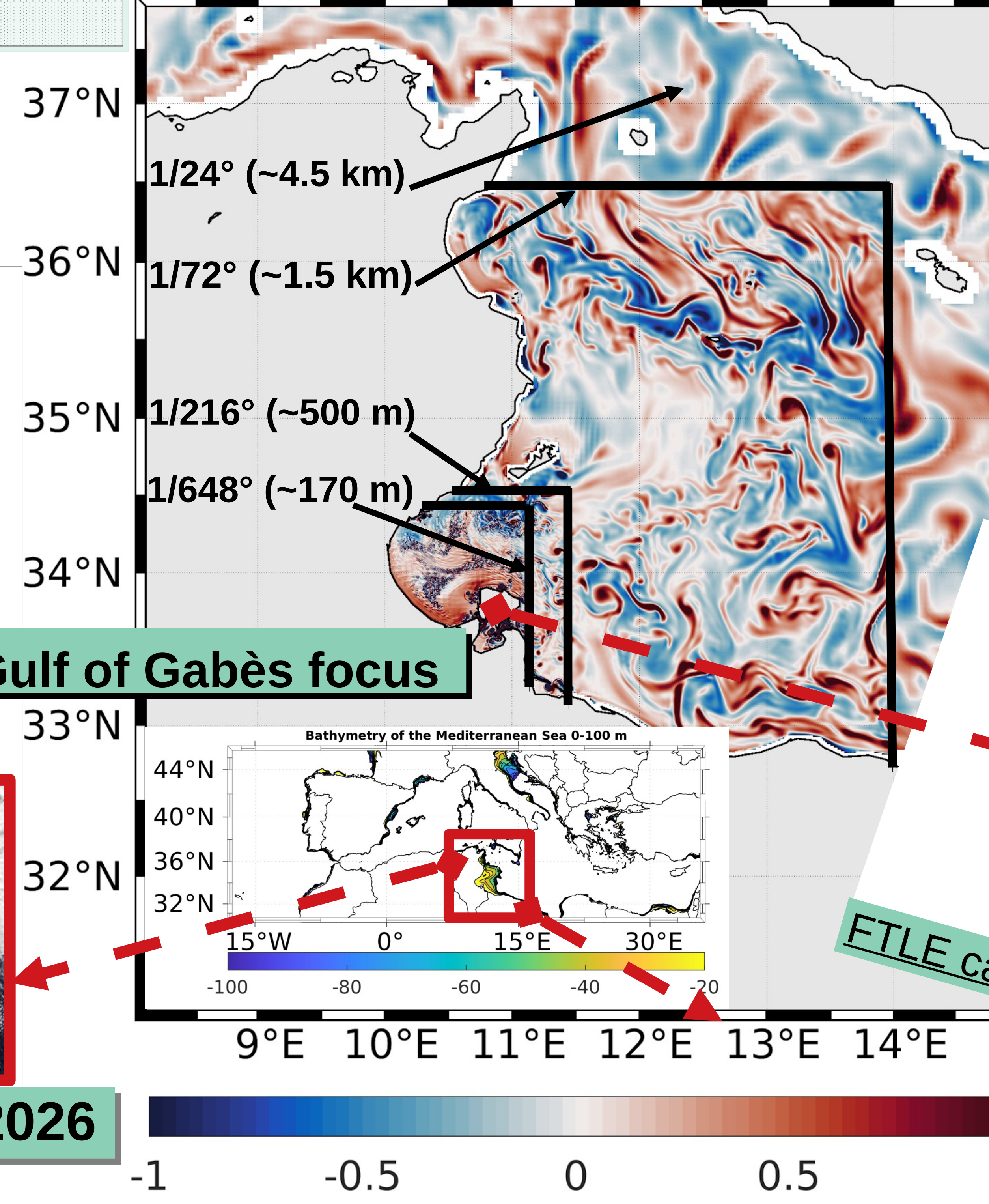
Scientific Gap → Submesoscale processes remain unresolved in operational systems. → Impact on coastal dispersion is poorly quantified.

Objective: Develop and validate a 170 m-resolution nested ocean model to resolve submesoscale dynamics and improve coastal transport prediction on the Tunisian shelf.



Cyclone Harry, JAN 19, 2026

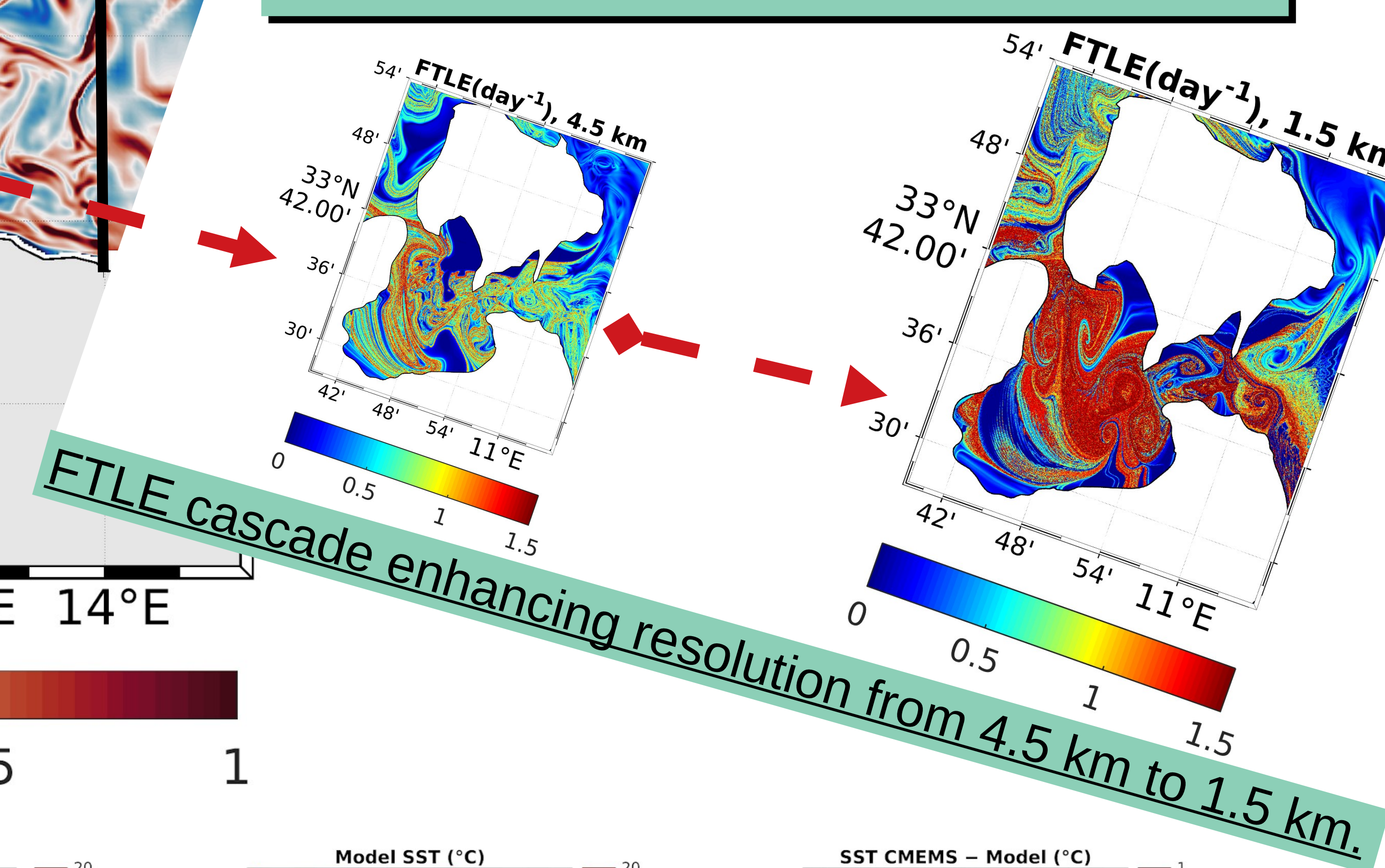
Vort*, 15 FEB 2026, 4.5 km → 170 m refinement.



Model Configuration

Multi-scale, two-way nested system.
→ CROCO: 1/24° → 1/648° (~170 m).
→ Two-way nesting ensures scale interaction. → 3-hourly outputs.
→ Boundaries: Mediterranean analysis.

Multi-scale two-way nesting enables explicit submesoscale resolution.



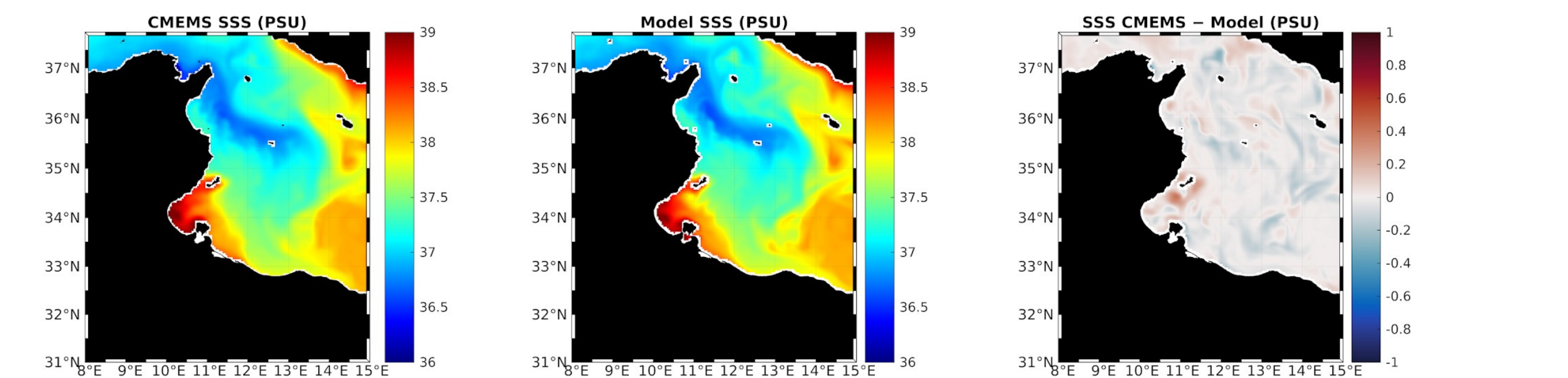
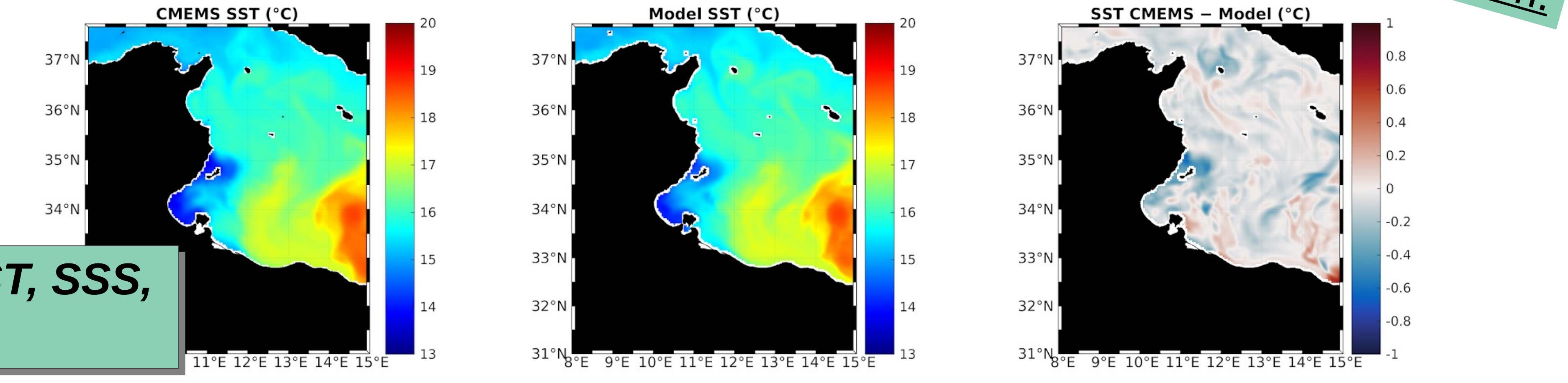
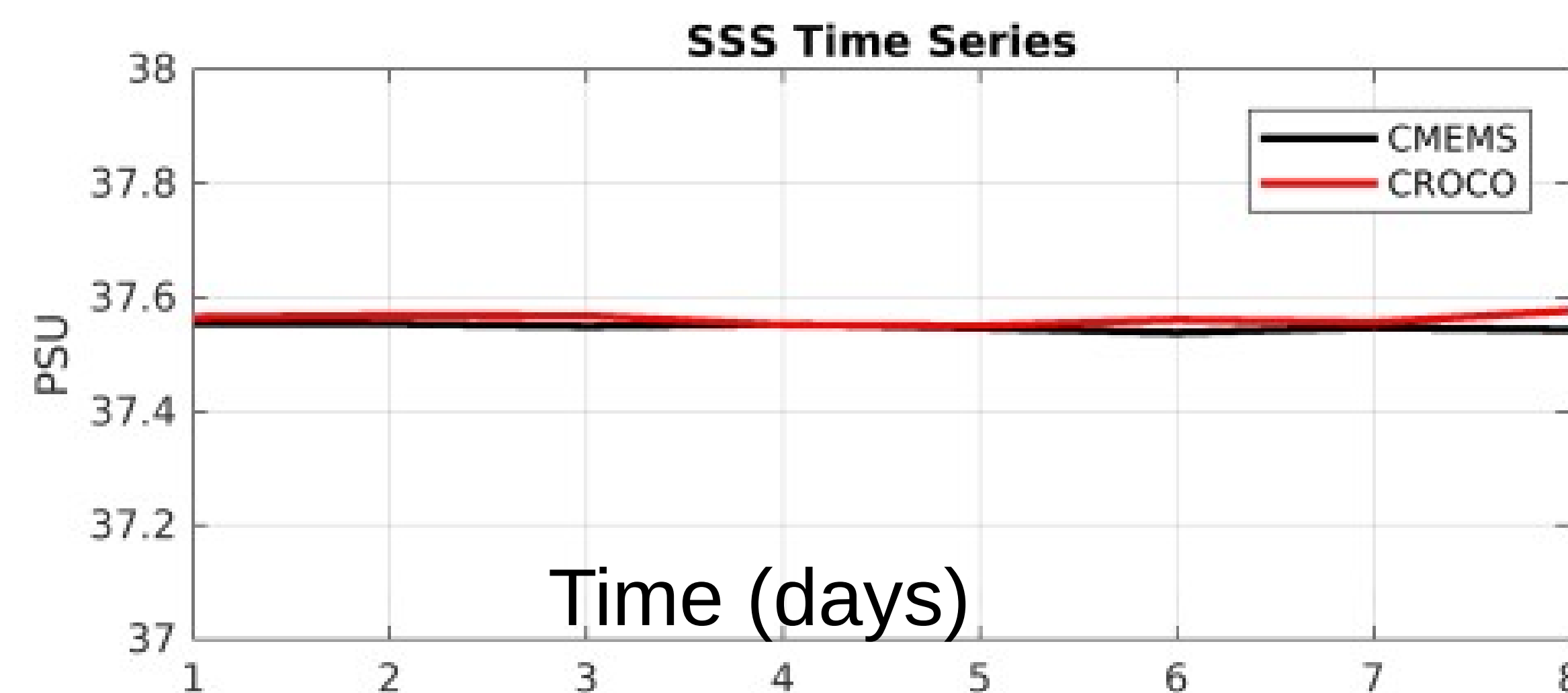
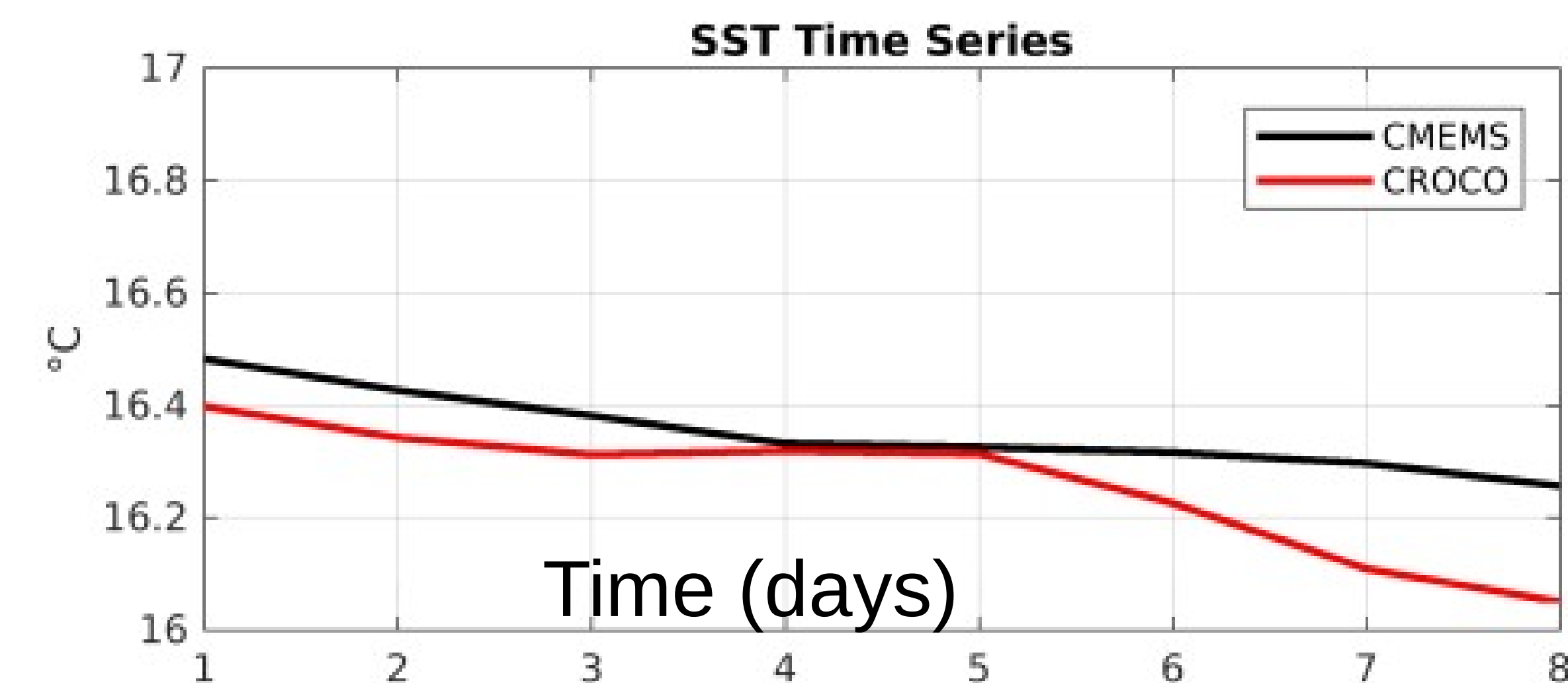
2. VALIDATION & RESULTS

The model robustly reproduces large-scale ocean dynamics

(9-15 FEB 2026):

- Accurate SST & SSS.
- Realistic KE & EKE patterns.
- Low bias.

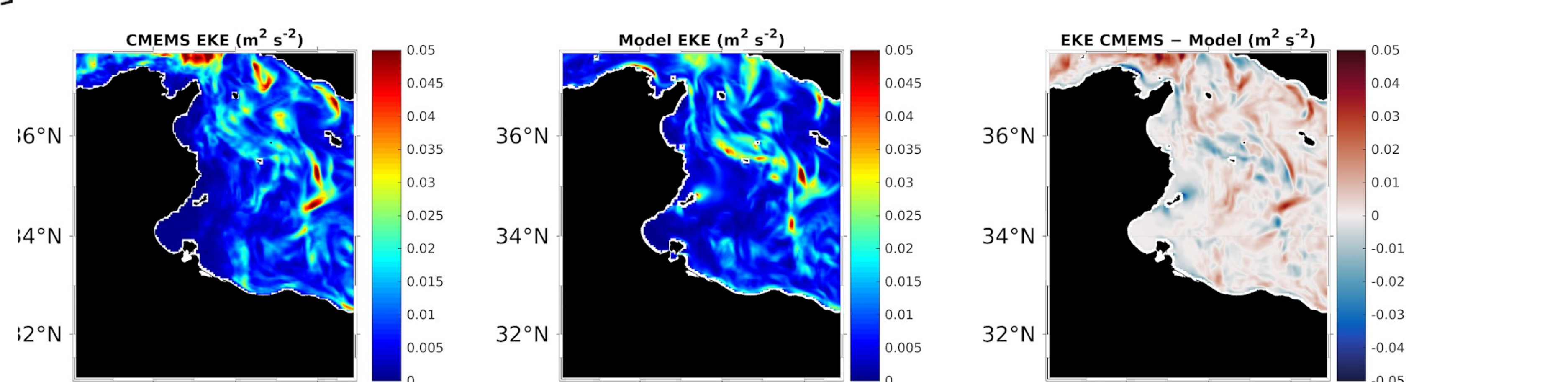
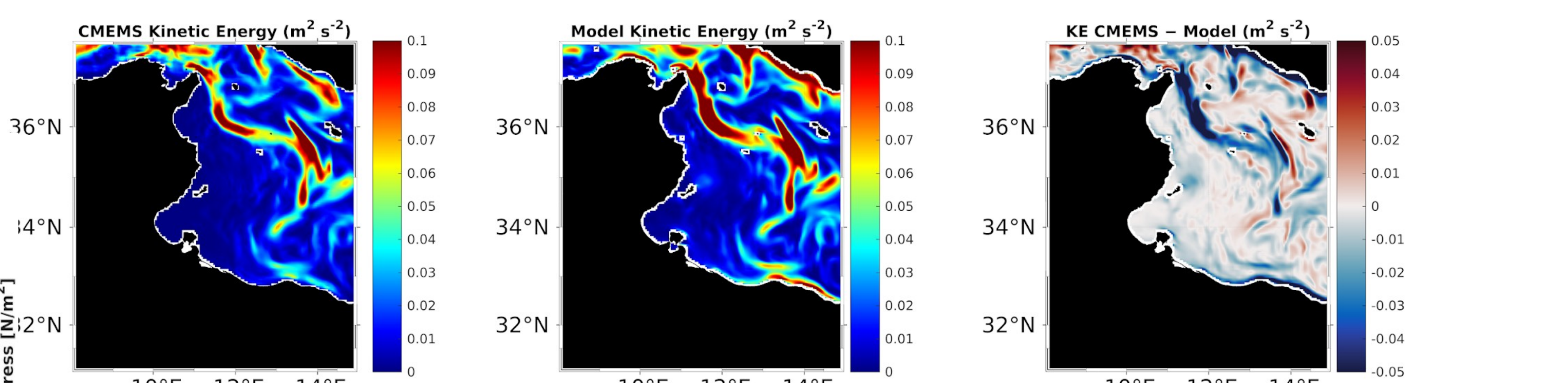
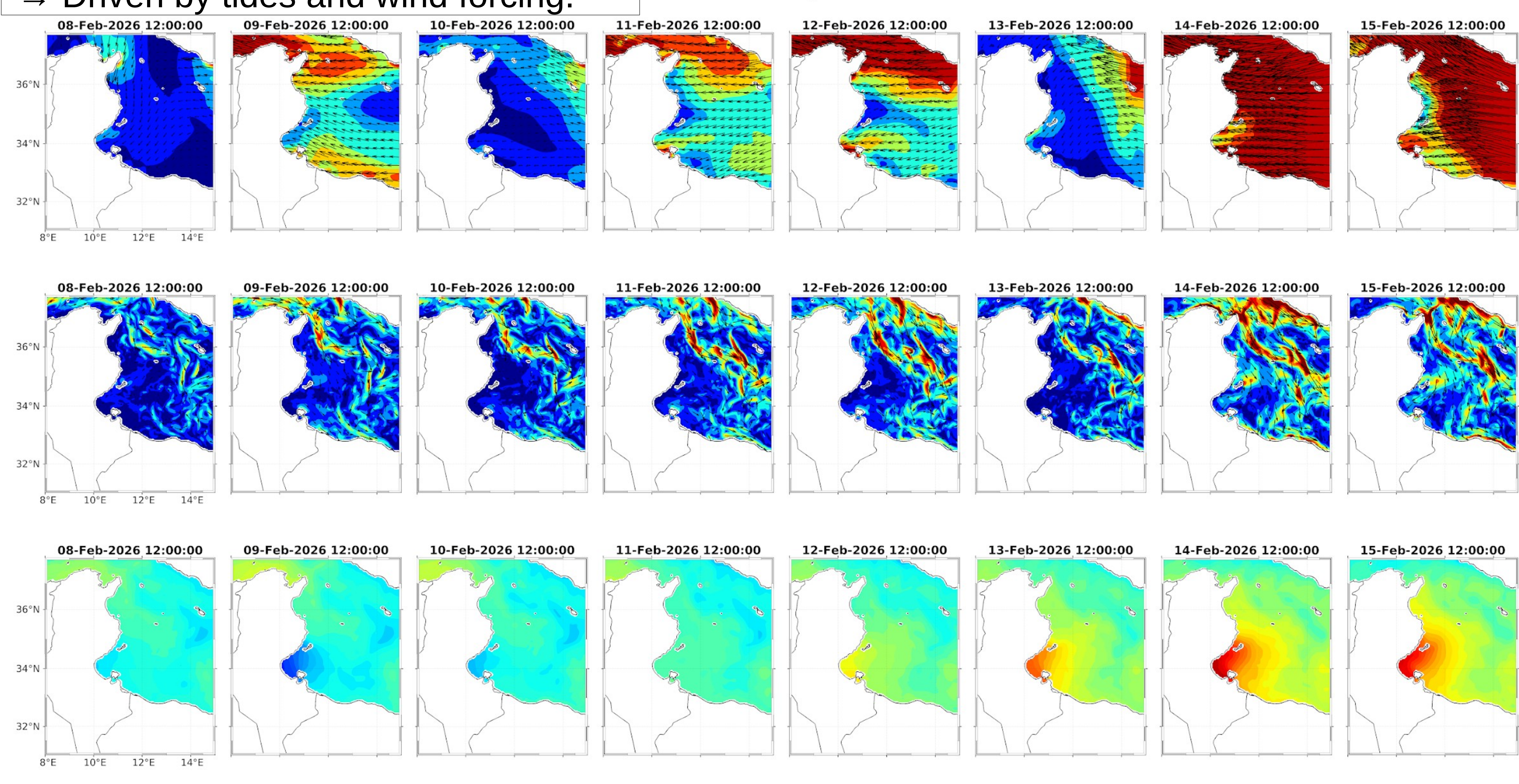
Comparison with CMEMS products shows strong agreement in SST, SSS, KE, and EKE: → demonstrating robust performance.



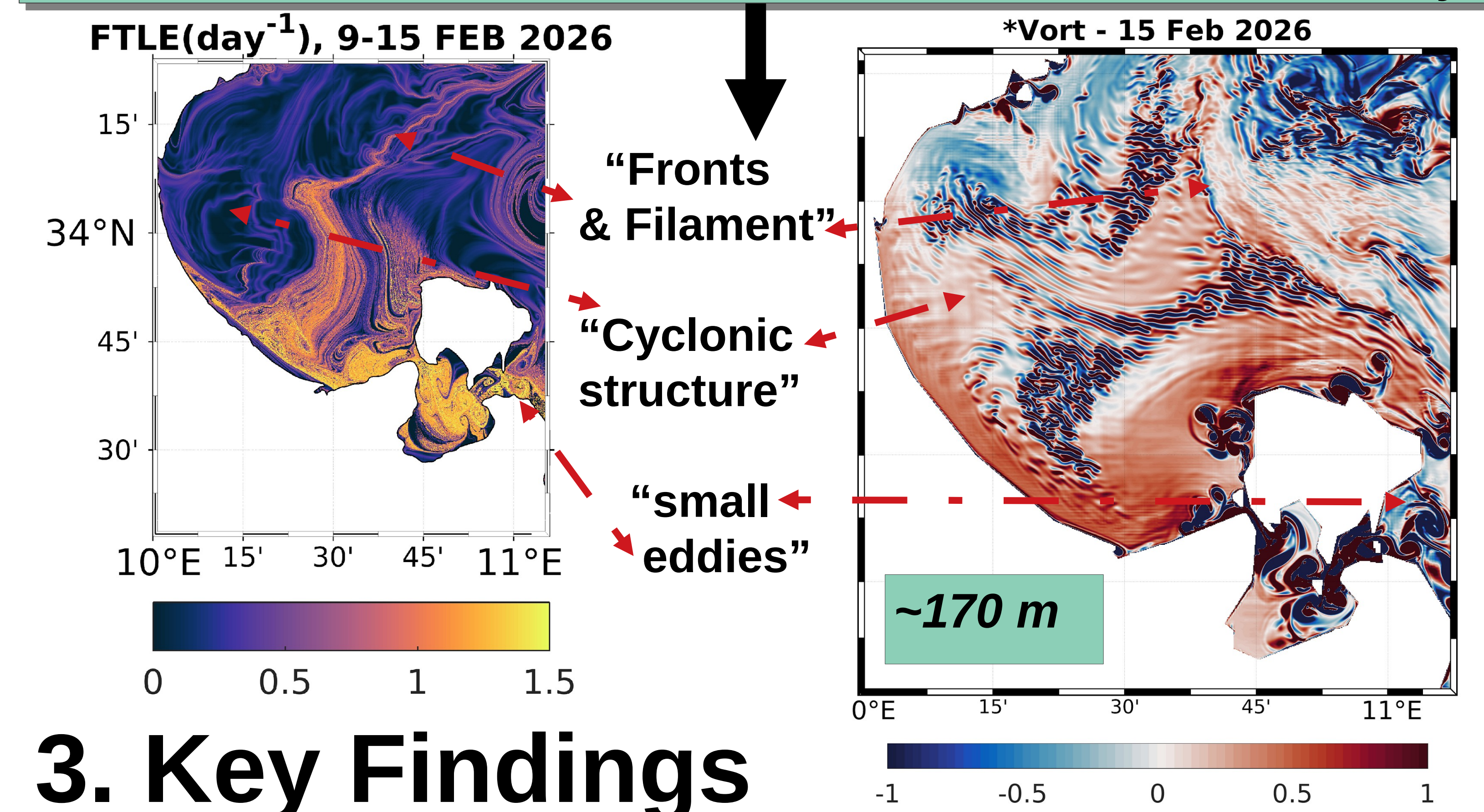
Forecast Dynamics:

- Strong spatial heterogeneity.
 - Active coastal transport pathways.
- Driven by tides and wind forcing.

CROCO Forecast Diagnostics - 9-Feb-2026



Vort* and FTLE forecasts show intense submesoscale activity.



4. Conclusion

- Submesoscale-resolving models are essential for realistic coastal forecasting.
- Two-way nesting enables cross-scale interactions.
- Significant implications for ecosystem dynamics and pollutant dispersion.

5. Future Work

- ❖ Biogeochemical coupling.
- ❖ Improving predictions of fish stock distribution.
- ❖ understanding the regional carbon cycle.
- ❖ Extended observational validation.
- ❖ Extreme-event forecast.

3. Key Findings

- 170 m resolution reveals filaments and barriers unresolved at 4.5 km.
- Enhanced transport realism significantly impacts dispersion pathways.
- Strong coupling between tides, wind forcing, and coastal circulation.