Development of AOM2/EnKF ocean forecasting system

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COSIMA project is acknowledged for developing AOM suit

Bureau of Meteorology
Annual R&D Workshop

23-26 November 2020

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DA system configuration

Spinup and initial performance

General verification

Summary

Introduction

BoM/Bluelink: planned transition to a new ocean forecasting system

Model: OFAM3[1] $\rightarrow$ AOM2-01[2]

- ocean only (MOM5) $\rightarrow$ coupled ocean/sea-ice (MOM5/CICE6)
- rectangular grid (0.1°, 75 S to 75 N, $3600 \times 1500 \times 51$) $\rightarrow$ global tripolar grid ($\sim 0.1^\circ$, $3600 \times 2700 \times 75$)

DA method: EnOI (EnKF-C) $\rightarrow$ EnKF (EnKF-C)

Bluelink global ocean forecasting:

- since 2016 - operationally using EnOI/OFAM3 system (with transition from BODAS to EnKF-C)
- 2012 - development of EnKF/OFAM2
- 2017 - development of EnKF/OFAM3
- 2020 - development of EnKF/AOM2-01

[1] OFAM3 = Ocean Forecasting Australia Model v.3 (Oke et al., 2013)
[2] AOM2-01 = ACCESS Ocean Model v.2 0.1-degree (Kiss et al., 2020)

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DA system configuration

- AOM2-01, coupled ocean/sea-ice (MOM5/CICE6)
- EnKF (EnKF-C)
- 96-member ensemble
- SLA from RADS, SST from NAVO, VIIRS, AMSR2, T and S from MMT, SIC from OSISAF ($\sim$ 19 M super-obs. per cycle)
- 3-day cycle
- Localisation: 150 km for SLA and SST, 450 km for T and S
- R-factors: 4.5 for SLA, 48 for SST, 18 for T and S
- 3% capped inflation
- Forcing pert.: 15% SW, 30% rain, 10% wind, 15% humidity, 0.2% T
- no SST bias correction

Resources:

- CPU: $\sim$ 120 kCPUh/cycle (up from 9kCPUh for EnKF/OFAM3)
- Footprint: 7 – 11 TB
- Full ensemble restart: 1.8 TB

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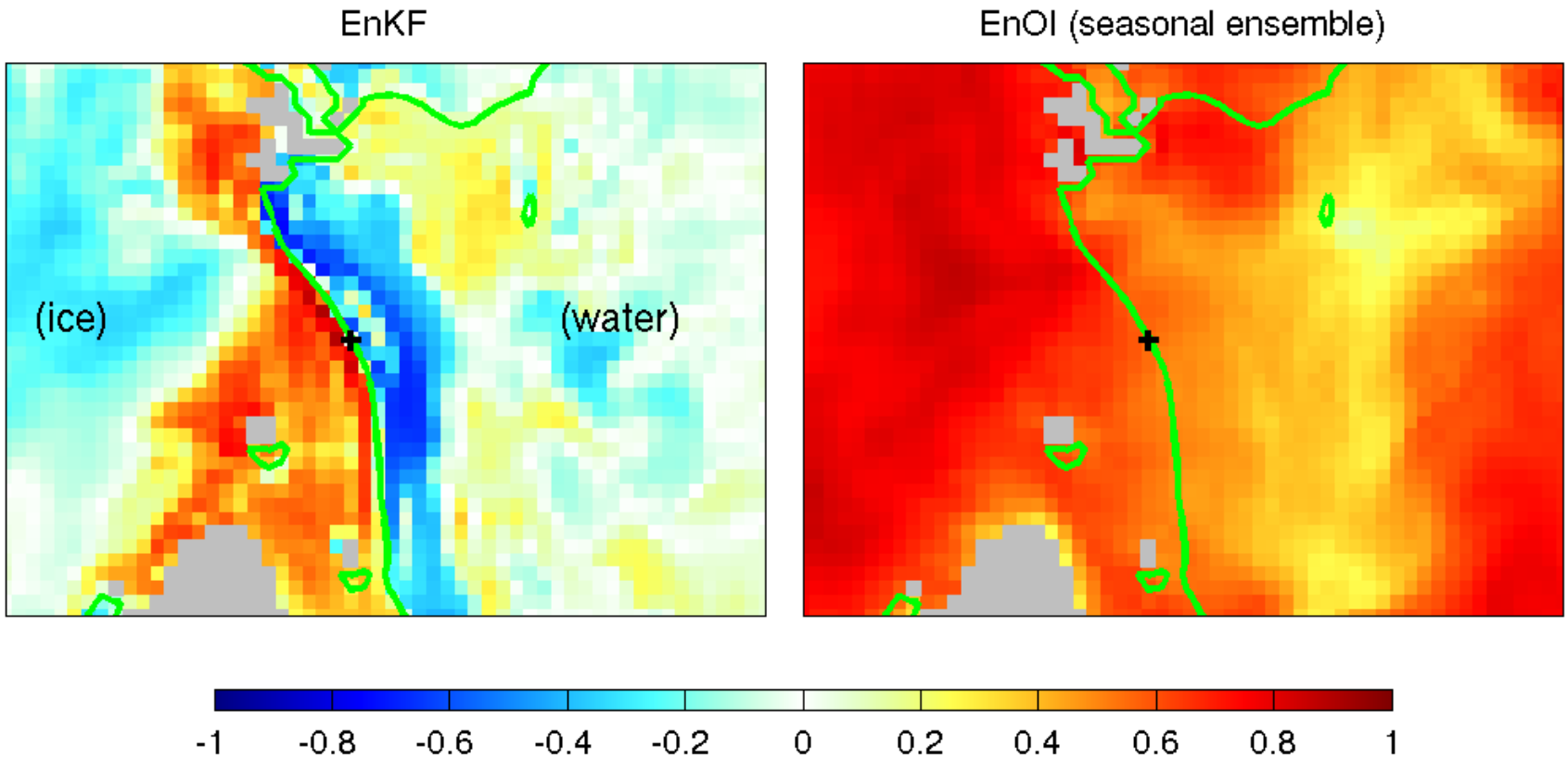
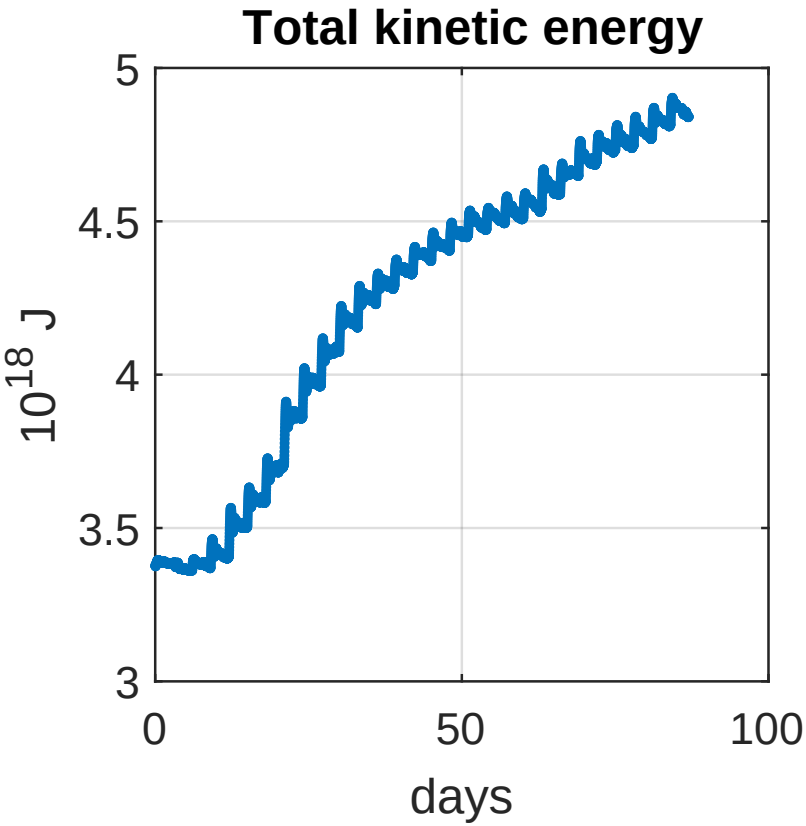
Dynamic covariance in sea-ice DA

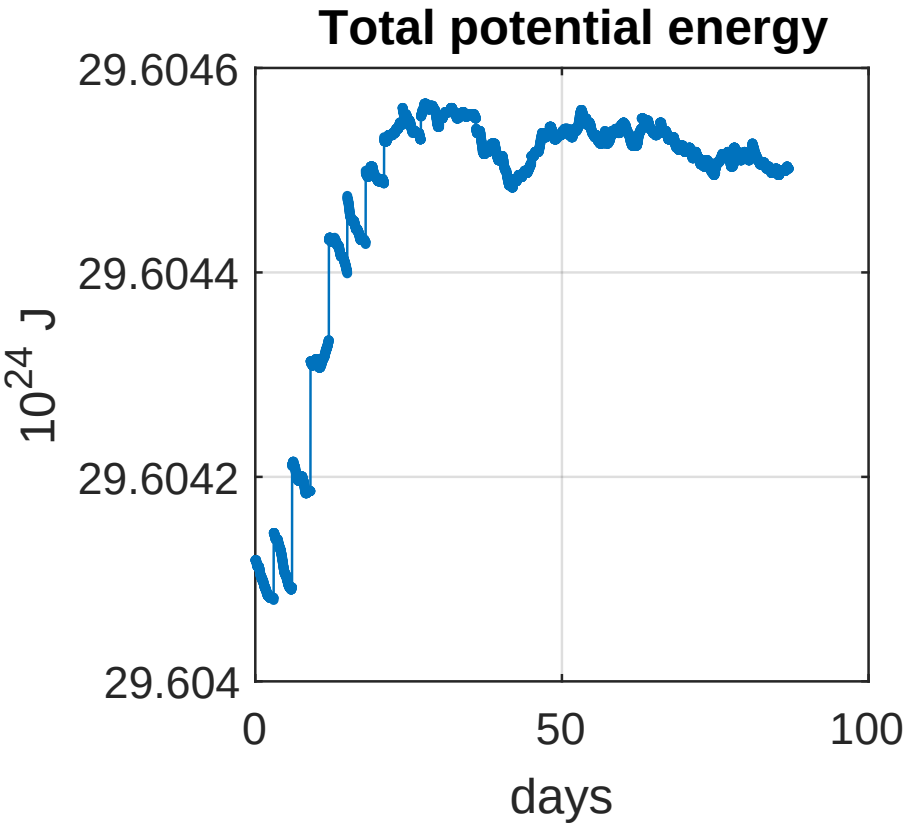
Example of correlation between SIC at location marked "+" and SSS
(Barents Sea, 27 June 2007, by TOPAZ4 ocean/sea-ice DA system)



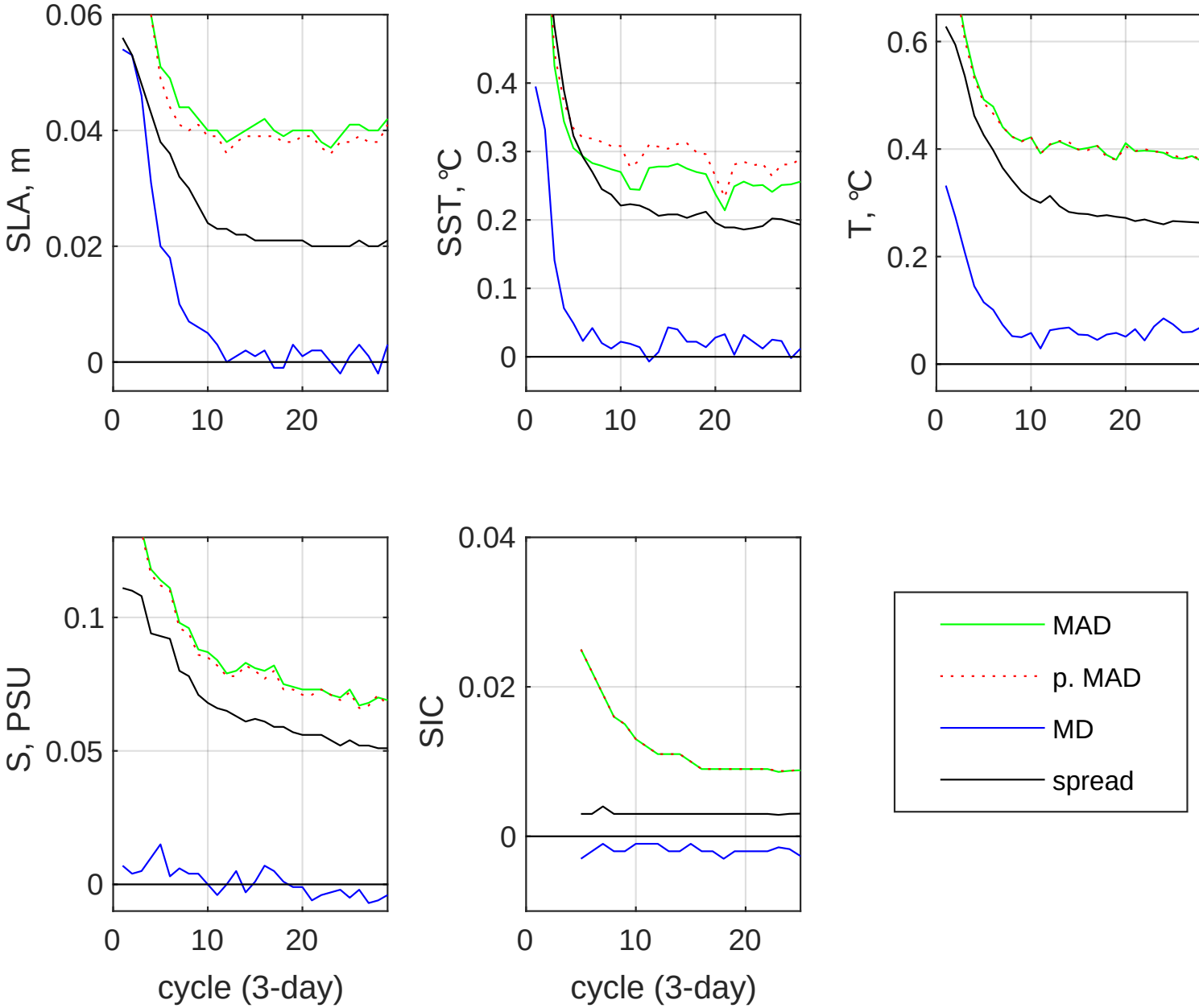
(from Sakov et al., 2012)

System spin-up: total energy

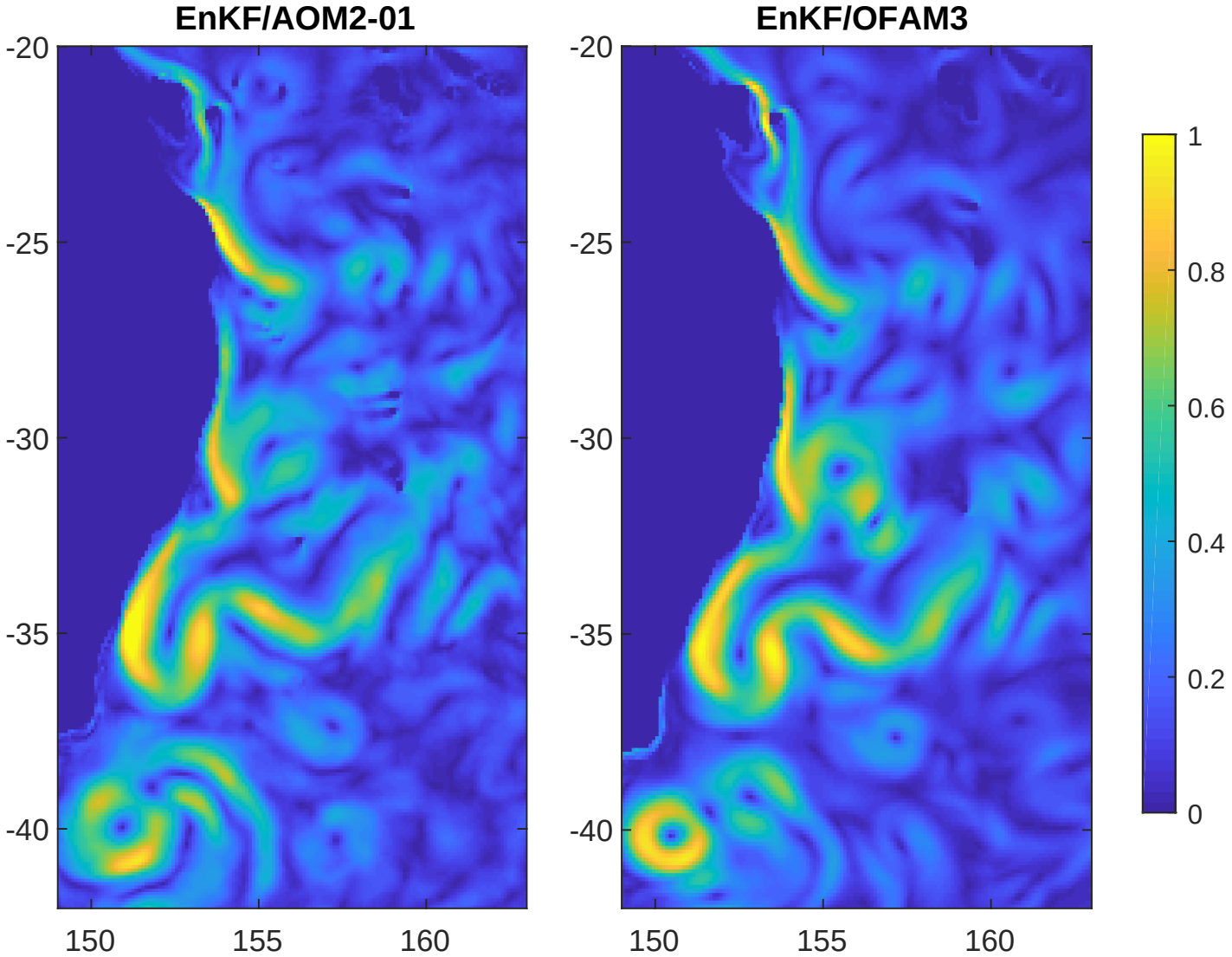




System spin-up: innovation statistics

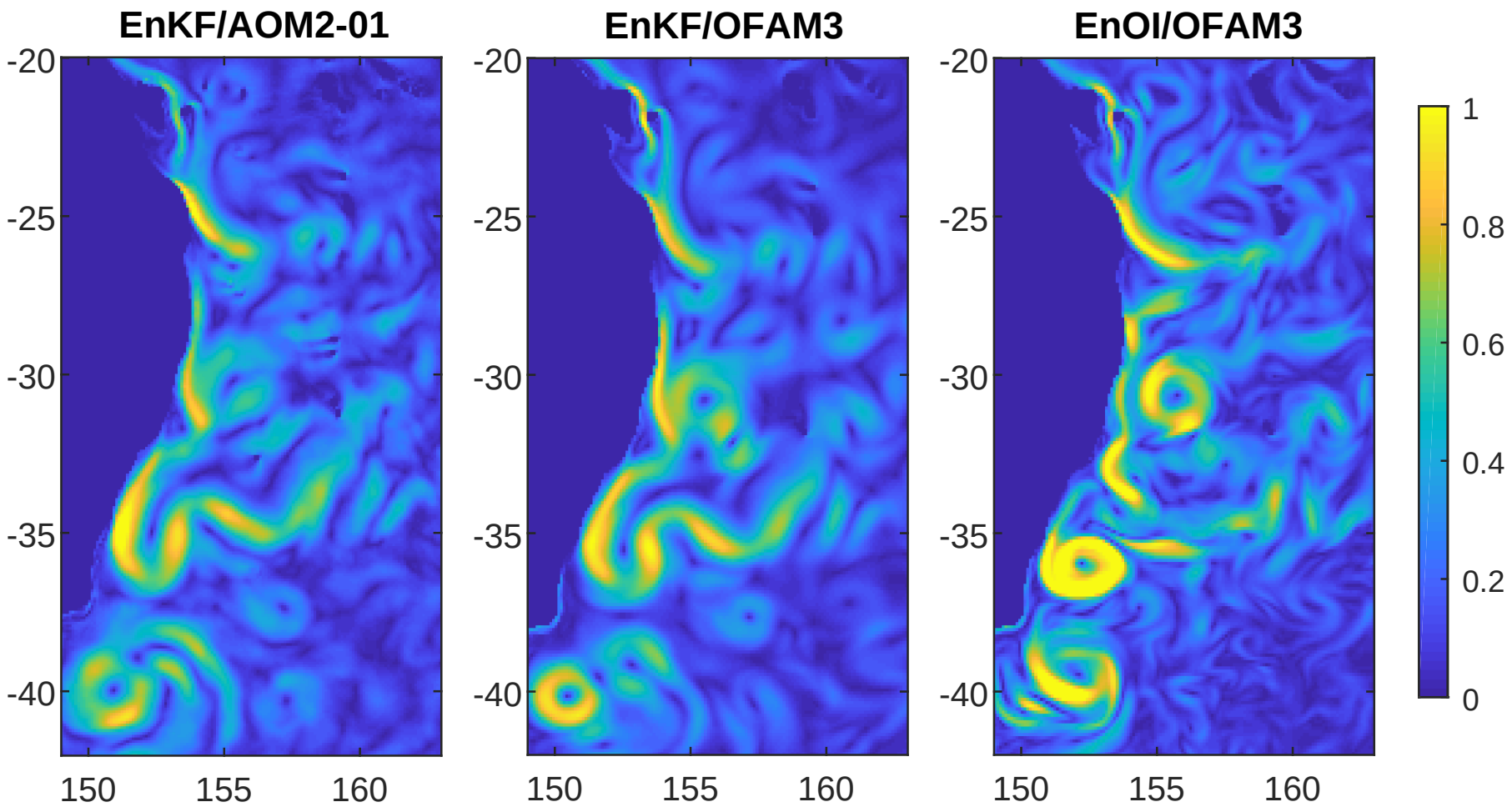


Comparison of absolute velocity field: EAC



AOM2-01: 29/3/2017, k = 22 (87 m)
OFAM3: 28/3/2017, k = 12 (85 m)

Comparison of absolute velocity field: EAC (2)



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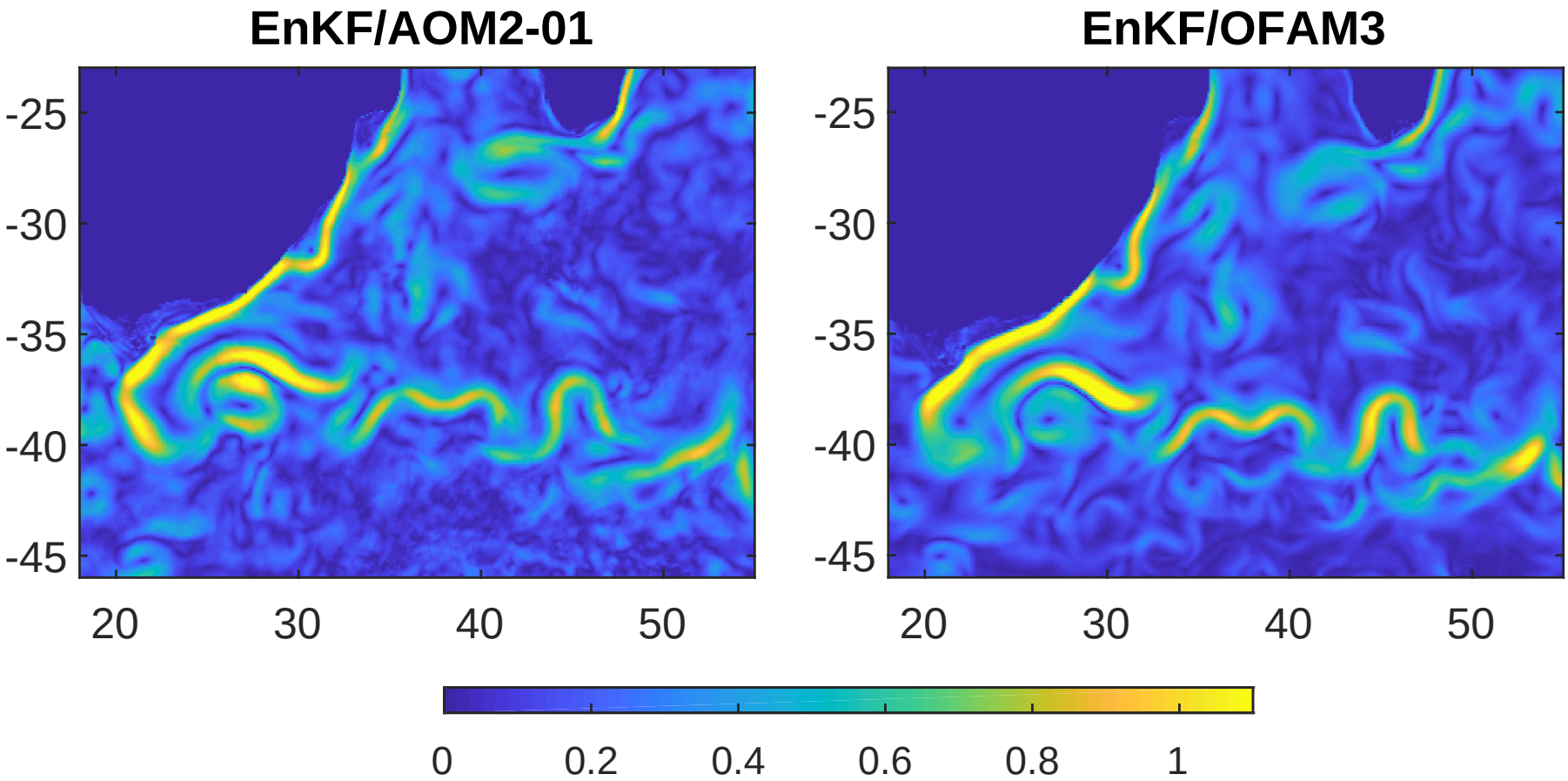
Comparison of absolute velocity field: Agulhas



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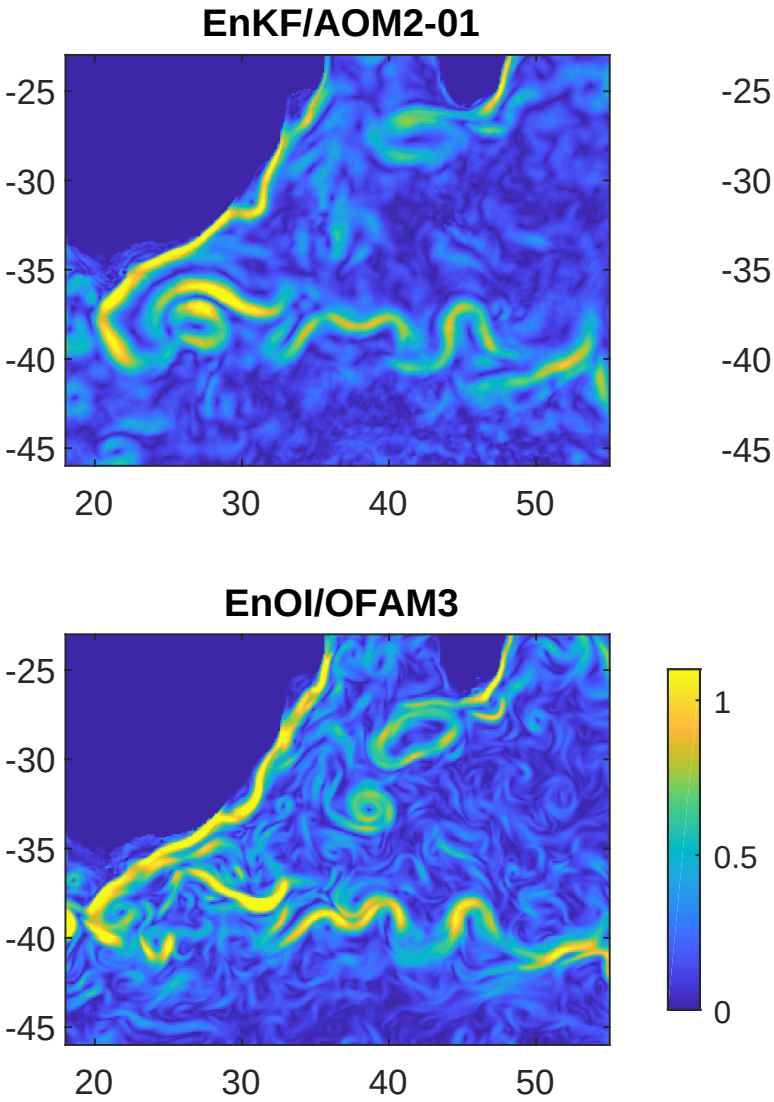
Comparison of absolute velocity field: Agulhas (2)



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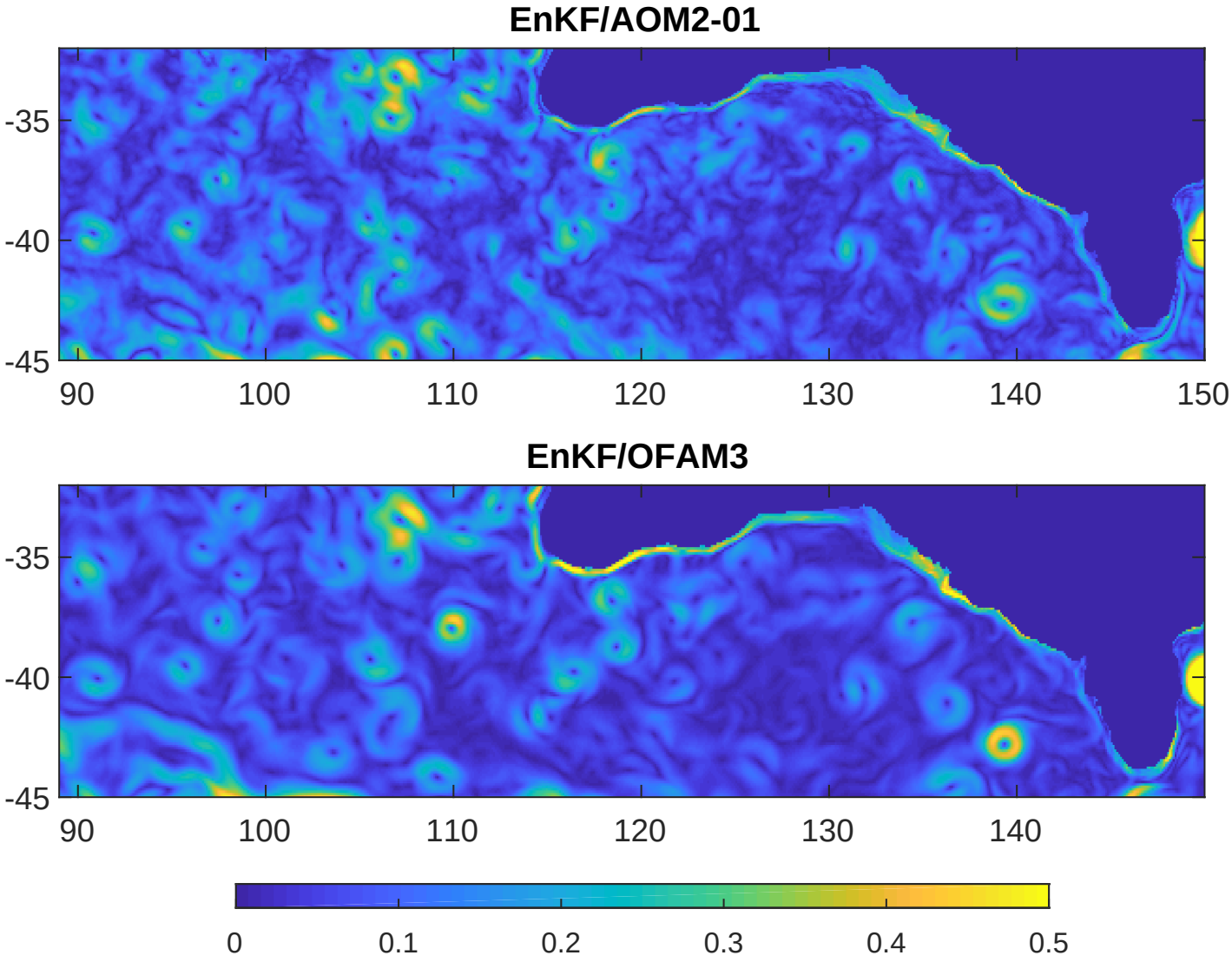
Comparison of absolute velocity field: South-West of Australia



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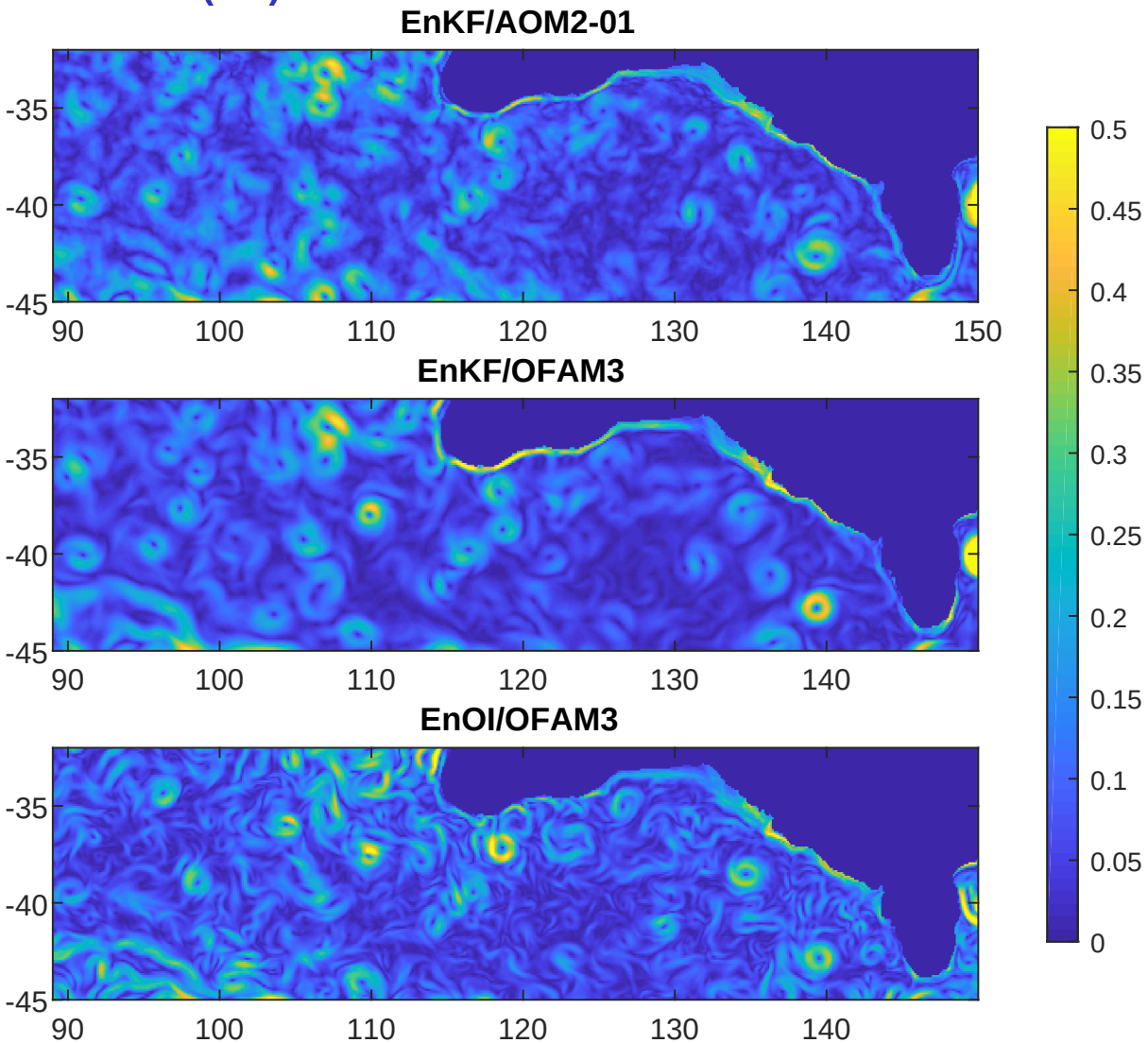
Comparison of absolute velocity field: South-West of Australia (2)



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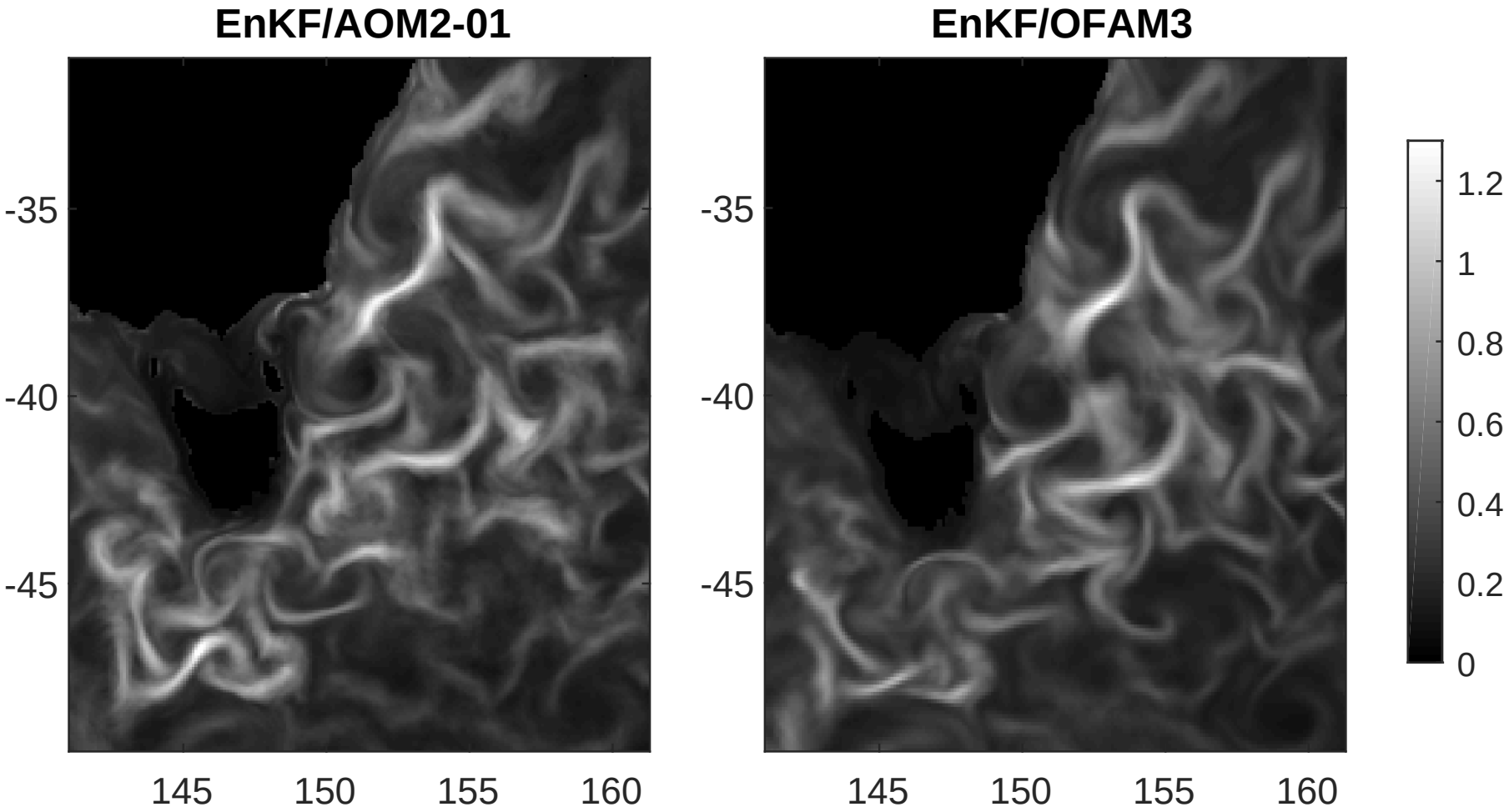
Comparison of SST ensemble spread: EAC



AOM2-01: 29/3/2017
EnKF/OFAM3: 28/3/2017

Summary

- EnKF/AOM2-01 ocean/sea-ice forecasting system is being developed at BoM and progresses towards maturity
- The system is 10+ time more expensive computationally than EnKF/OFAM3
- Based on initial 30-cycle run, the performance is quite good, particularly for subsurface T and S
- Similarity between the reconstructed velocity fields and SST ensemble spread fields brings confidence in the two EnKF DA systems

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References

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Oke, P., D. Griffin, A. Schiller, et al., 2013: Evaluation of a near-global eddy-resolving ocean model. *Geosci. Model Dev.*, **6**, 591–615.

Sakov, P., 2014: EnKF-C user guide. *CoRR*, **abs/1410.1233**.
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