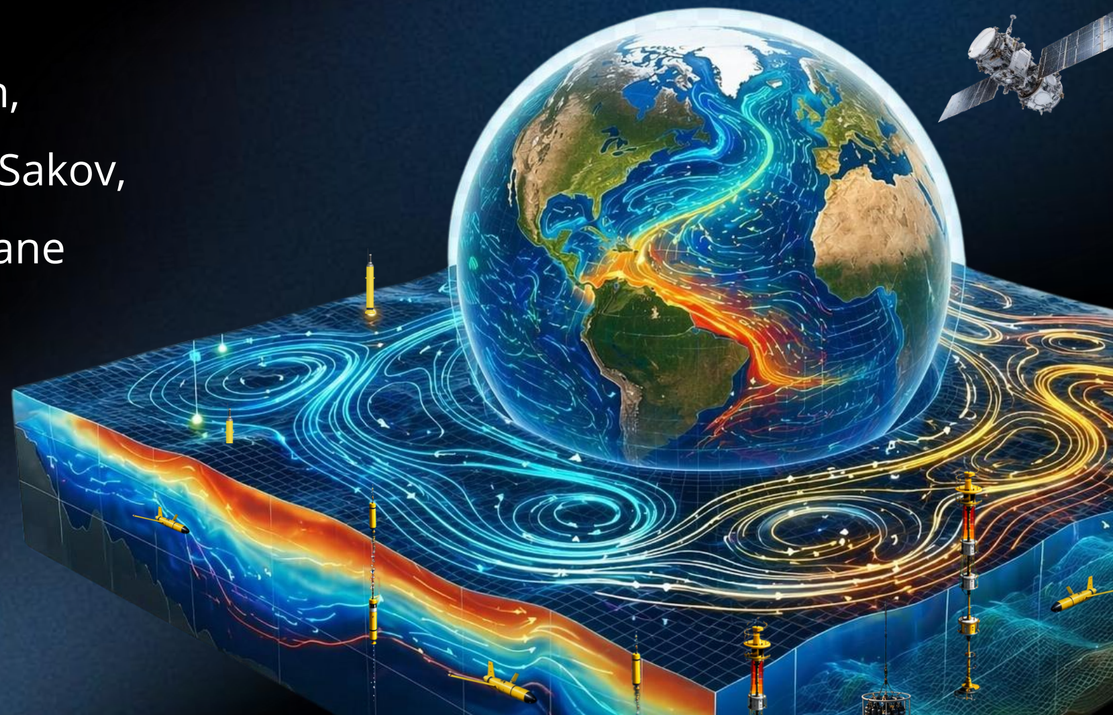
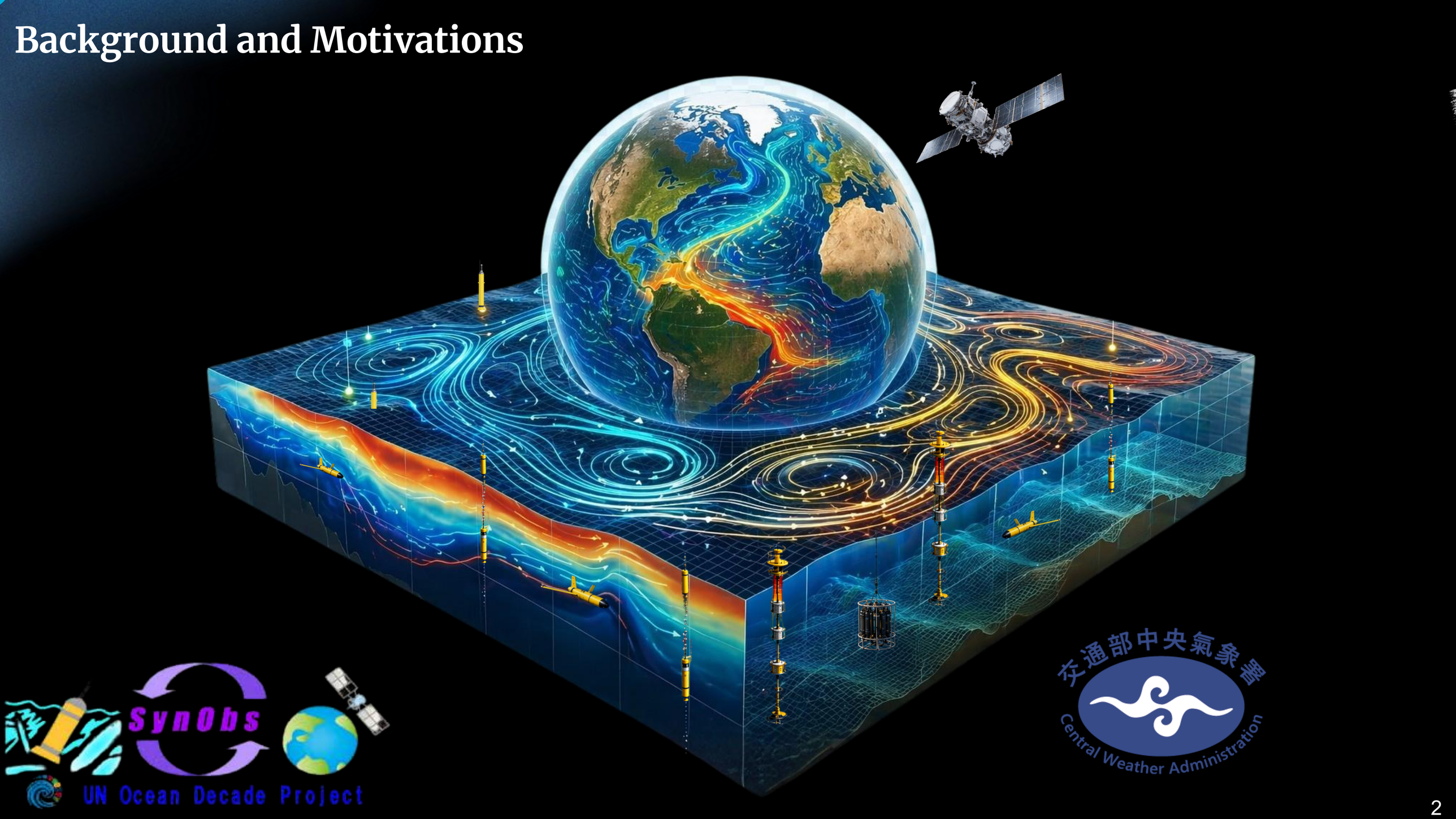
AN ENOI OCEAN DATA ASSIMILATION SYSTEM FOR THE GEPSV3 COUPLED PREDICTION SYSTEM: DEVELOPMENT, TUNING, AND INTERCOMPARISON

Presented by: Lalu MW Paksi

Yu-Heng Tseng, Ming-En Hsieh,
Wei-Liang Lee, Vassili Kitsios, Pavel Sakov,
Paul Sandery and Terence J. O'Kane



Background and Motivations



SynObs
UN Ocean Decade Project

交通部中央氣象署
Central Weather Administration

OBJECTIVE



交通部中央氣象署
Central Weather Administration

SynObs
UN Ocean Decade Project

Observation Evaluation
Evaluate observing system importance

Observation Integration
Assess synergy between satelite and in situ

Enhanced Quality
Optimize future network design

Better Operational
Co-design framework between observing, prediction and operational

Intercomparison
Establish evaluation best practices

Taiwan Multi-Scale Community Model (TIMCOM)

Tseng et al. (2012), Prog. Ocean

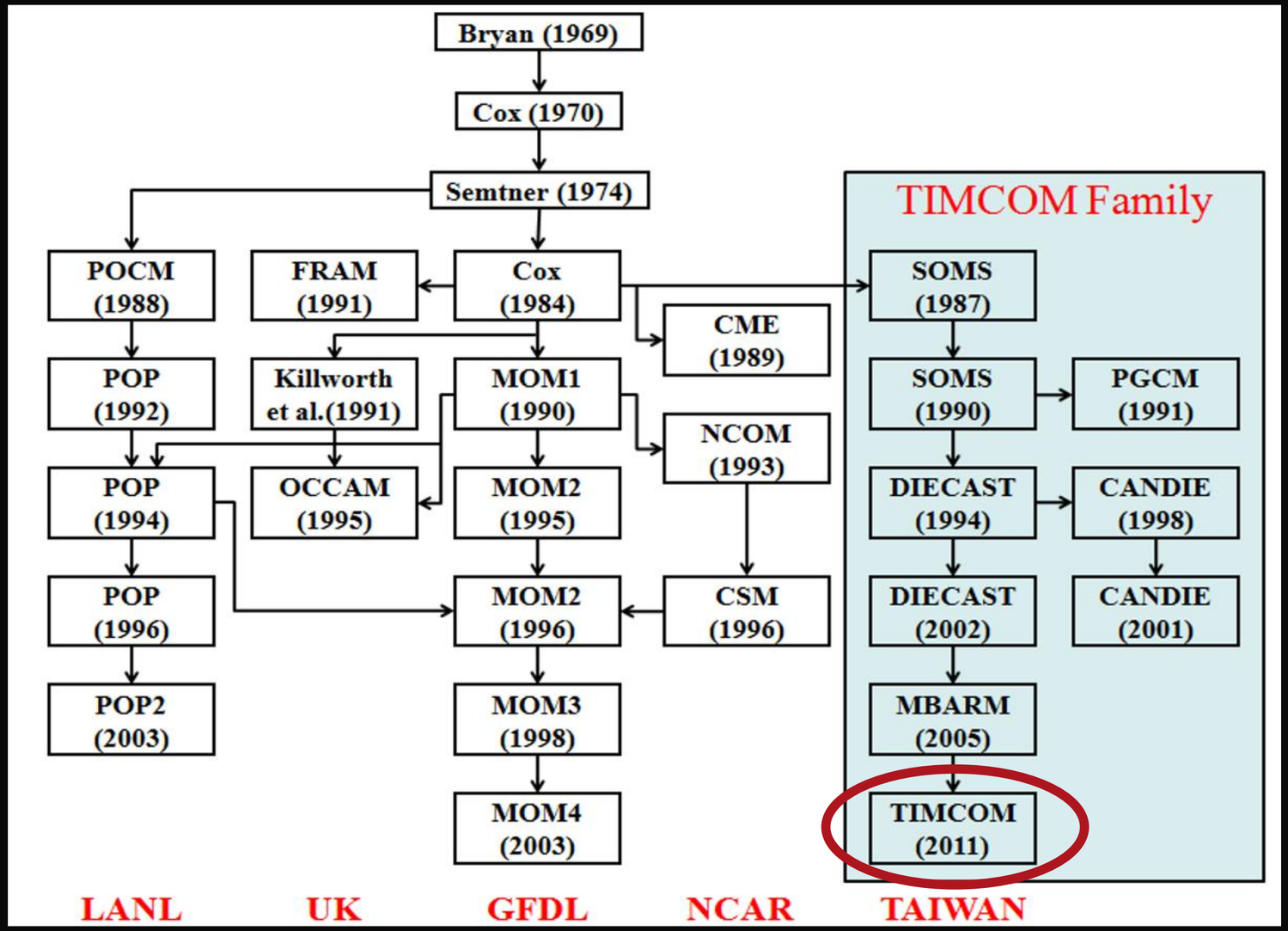
Tseng and Chien (2011), Comp. Fluids

Shen et al. (2011), J. Mar. Sys.

Shen et al. (2013), Prog. Ocean

Young et al. (2012), Env. Modell. Soft.

Young et al. (2013) MWR



http://140.112.66.144/research/timcom

GEPSv3 Framework

TIMCOM Initial condition
(From HYCOM)
- Current Velocity (U, V)
- Water temperature (T)
- Salinity (S)
- Sea Surface Height (SSH)

TCo383 Initial condition
(From CWA FV3TGFS)
- U,V wind
- Temperature
- Pressure
- Specific Humidity
- Water vapor
- Cloud Cover

Atmosphere - GFS TCO

TCo383
0.232O (~28 km)
72 Levels
Grid:1552x768x72

Coupler - MCT 2.11.0

exchange every 2 h

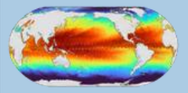
Ocean - TIMCOM

Grid:1536x720x55
0.234O (0.1O in Tropics)
55 Levels

Land surface
Noah LSM
(4 soil layers)

River runoff
prescribed

Sea-ice fraction
prescribed



SST
OISST L4



In-situ T/S Argo + WOD: mooring, XBT, CTD, OSD

Ocean background xf

offline EnOI

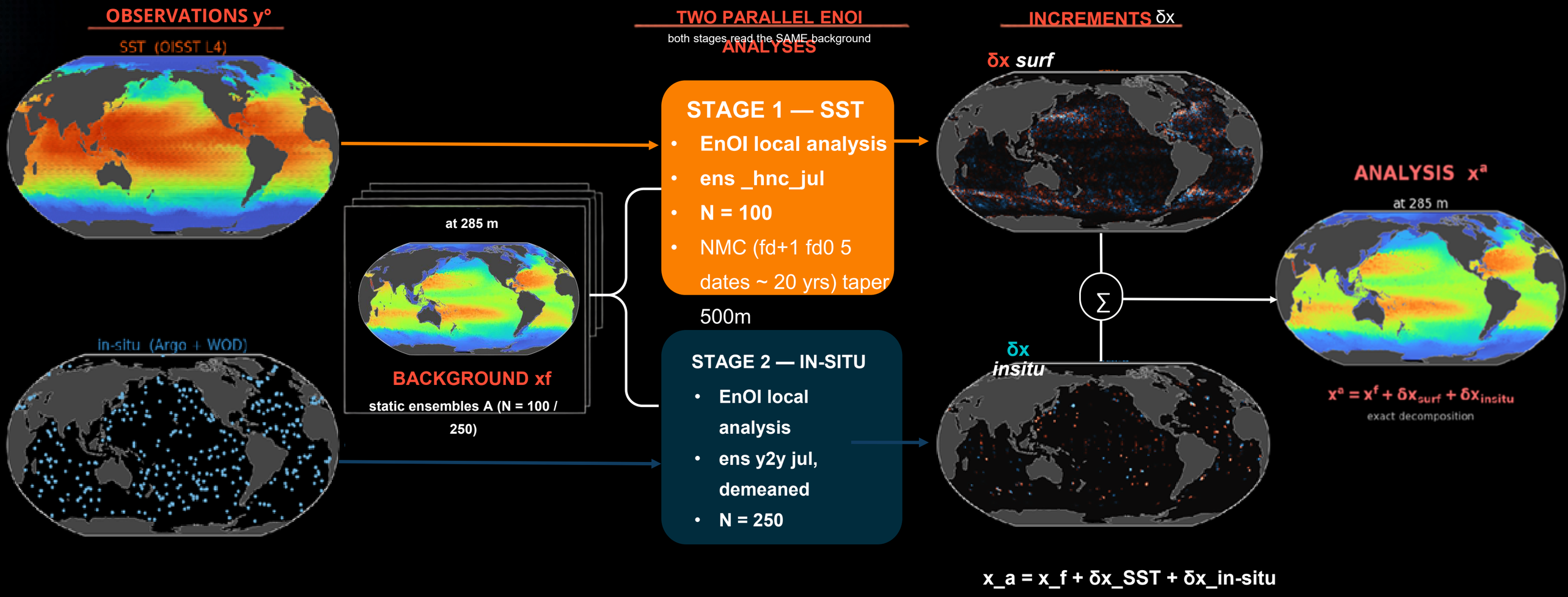
two-stage ocean analysis
(next panel)

Ocean analysis xa

next TIMCOM initial condition

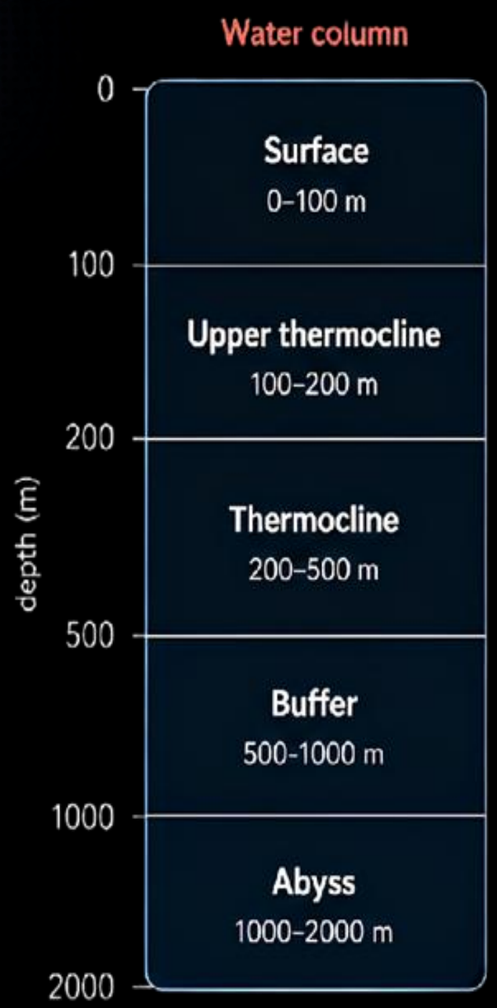
coupled physical exchange (online)
offline DA / initialization pathway
atmosphere / land
ocean
offline EnOI

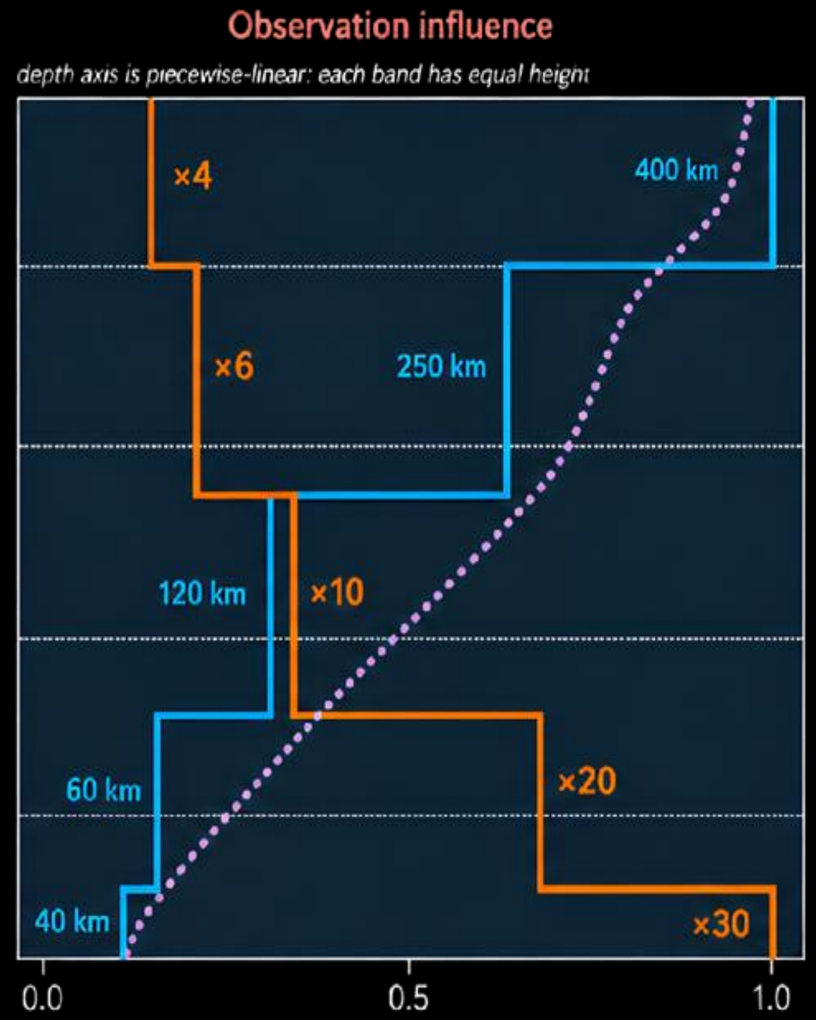
TIMCOM / EnKF-C two-stage EnOI analysis
15 July 2020, level 285 m



Evensen (2003); Sakov and Oke (2008); Sakov (2014)

Two-stage EnOI analysis





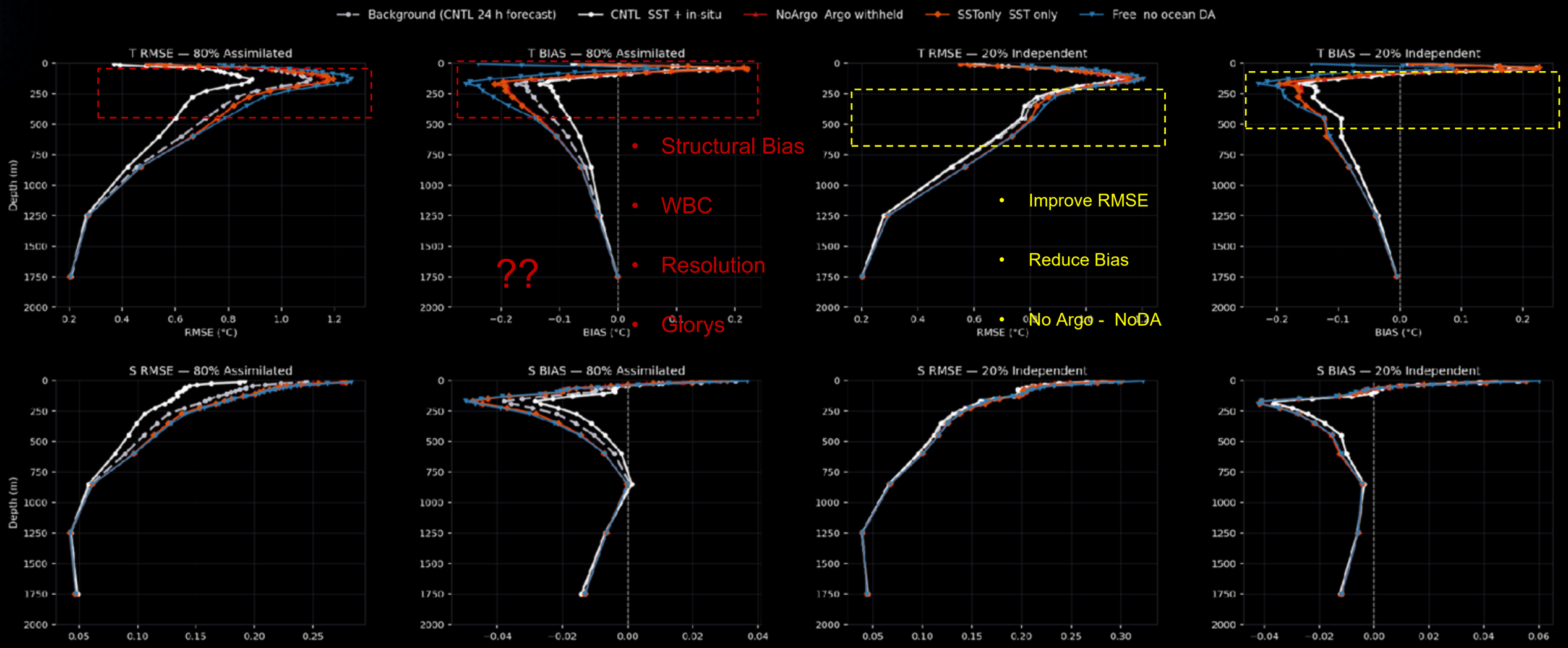
x°(z) = x'(z) + 6xssT(z) + Sxinsituz), with no w(z) applied to either term

- Localisation radius and error inflation are read from the obs-type configuration;
- Not Vertical Localisation
- LOCRAD + RFACTOR

- SST = RF16 + 800km BRAN2020

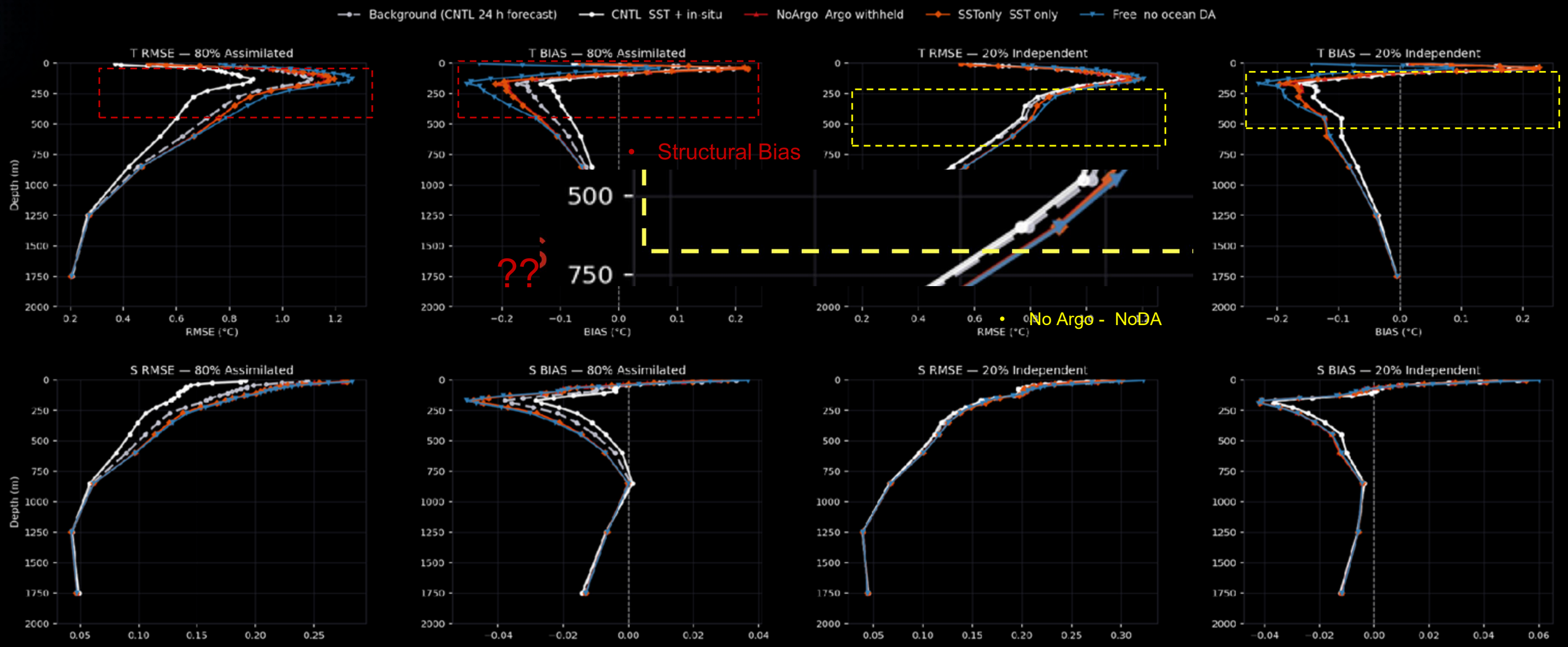
January 2020 Verification Against SynOBS Argo

(26 Analysis of 6-31 January)



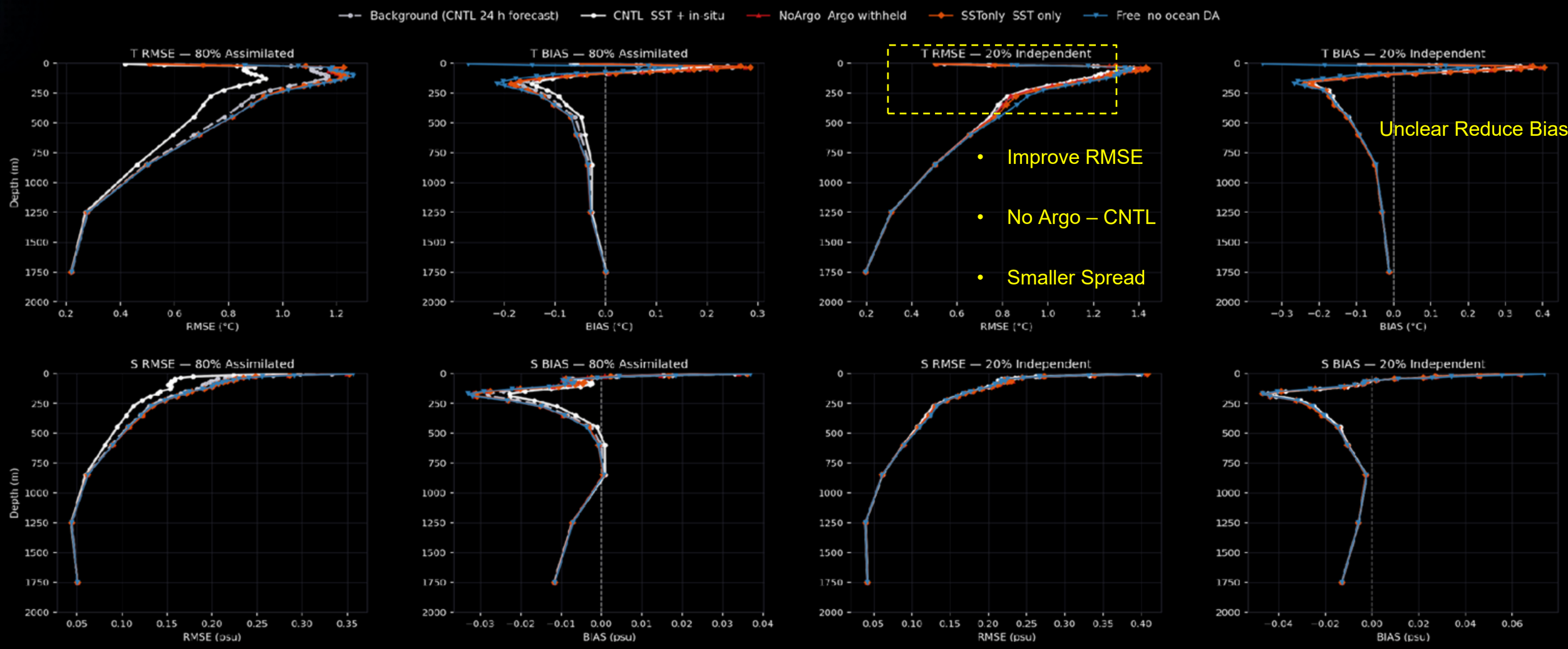
January 2020 Verification Against SynOBS Argo

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January 2020 Verification Against SynOBS Argo

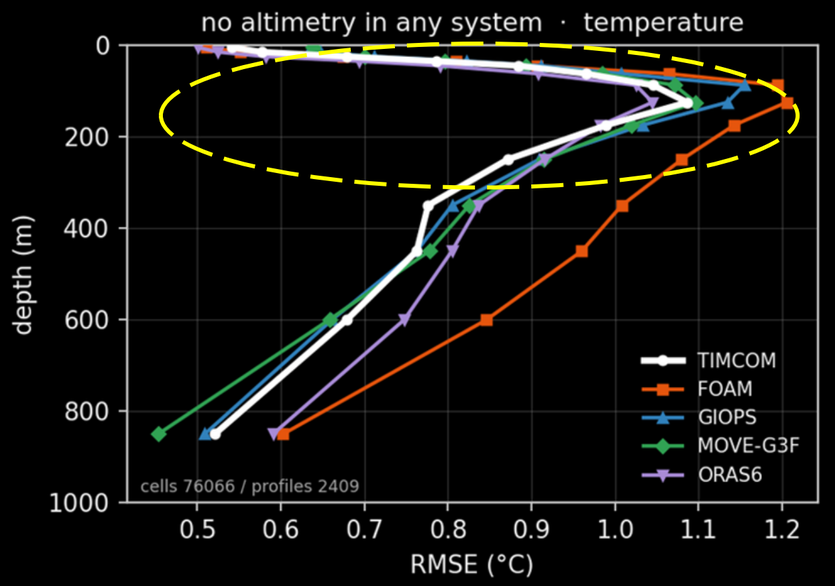
(26 Analysis of 6-31 July)

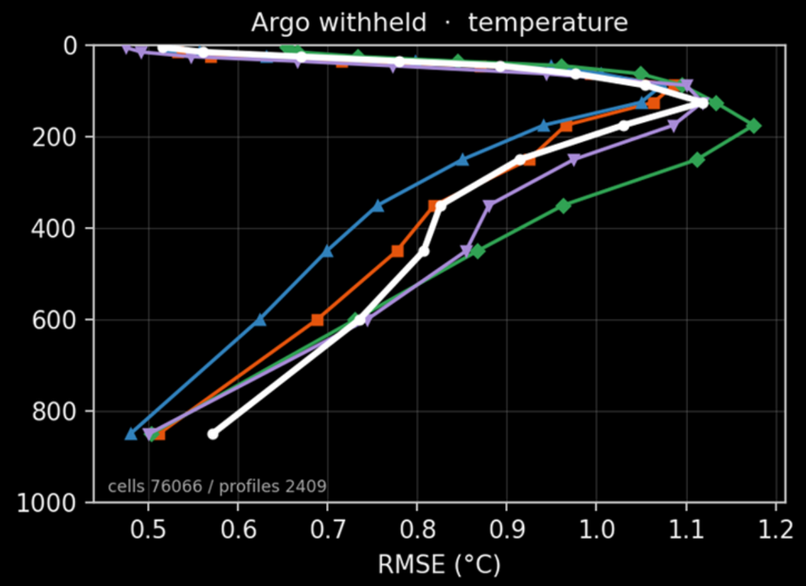


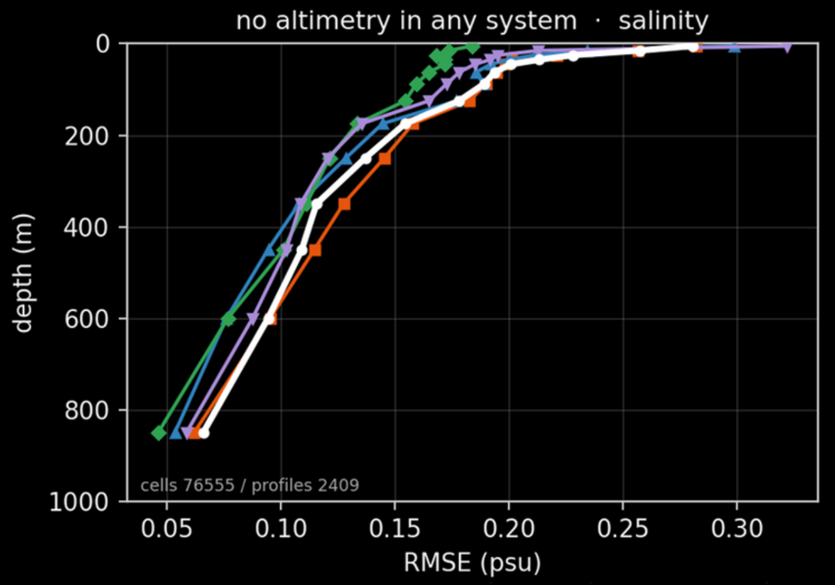
SynObs multi-model comparison against withheld ArRef

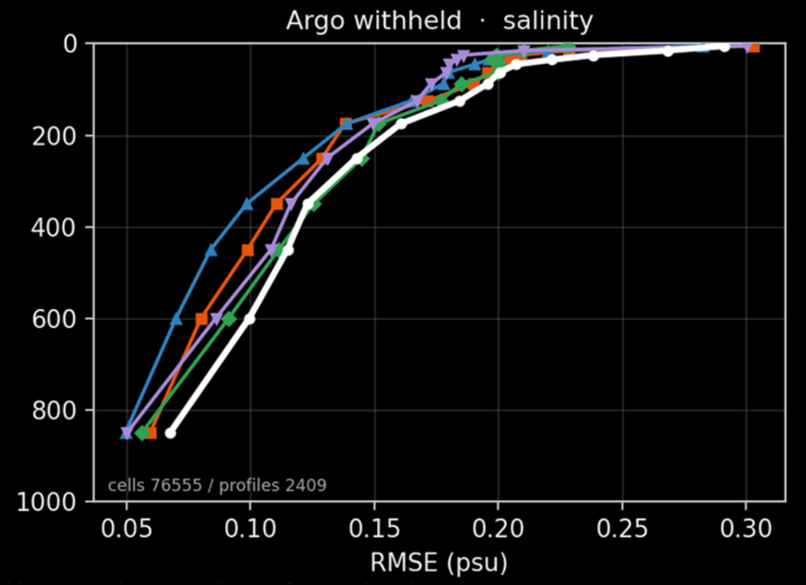
JANUAR

- TIMCOM is competitive in the upper ocean, especially around **100–400 m**
- Argo withholding increases subsurface temperature error, mainly around **100–600 m**
- Salinity degrades more strongly without Argo, especially around **200–700 m**
- The main limitation is intermediate-to-deep ocean covariance representation





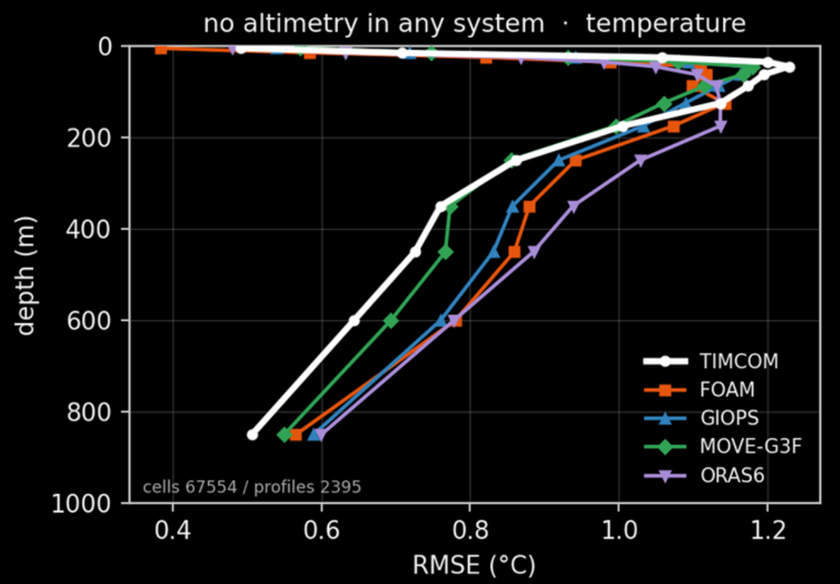


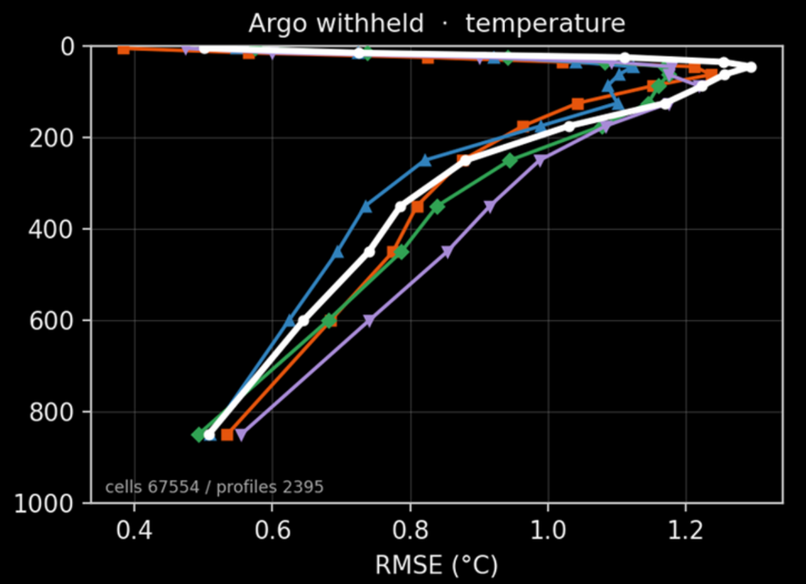


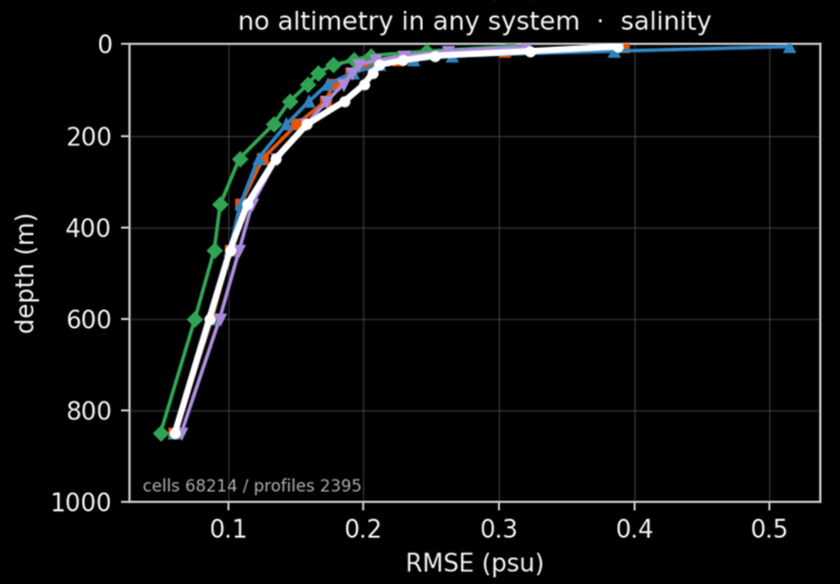
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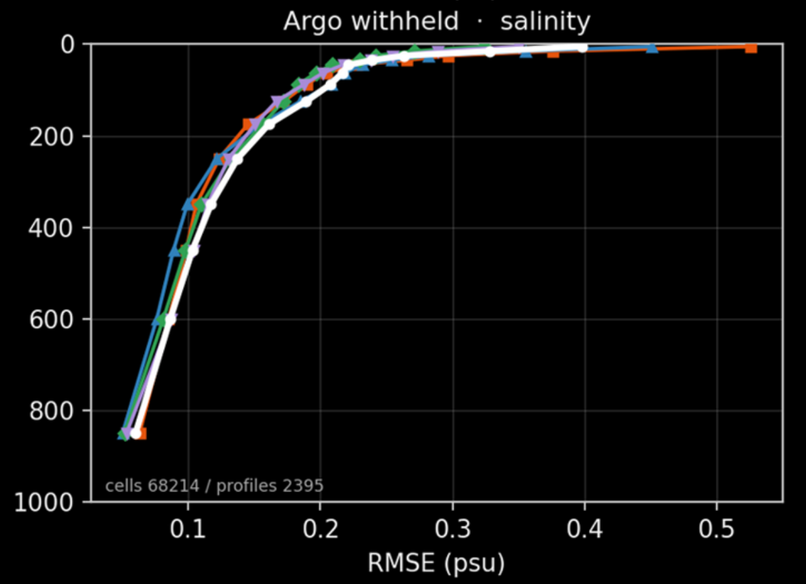
JULY

- TIMCOM is competitive near the surface and in much of the upper ocean
- Argo withholding increases temperature RMSE mainly at **100–600 m**
- Argo-related salinity degradation is clearest above **300–400 m**
- Deep convergence indicates lower discrimination, not no Argo value
- The main limitation is vertical covariance and subsurface ensemble representation









TAKE HOME MESSAGES

The system works and cycles

01 A two-stage offline EnOI initialises GEPSv3 ocean, cycling stably for a month in contrasting seasons.

Observations measurably help, and we can say how confidently

02 Withholding any stream degrades analysis against independent withheld Argo.

The next gain is in the ensemble, not the tuning

03 July's deep spread is thinner than January's, and the DA becomes inactive below 500m.

Open Discussion

01

Vertical localisation

Should it follow depth, or the local dynamical regime? The ladder is fixed globally, yet the error structure follows the thermocline.

02

Bias Correction

How should T and S bias correction be incorporated, given the deep bias is inherited from the seed rather than generated by the model?

03

Ensemble Spread

How to improve the ensemble spread with limited 20yrs hindcast

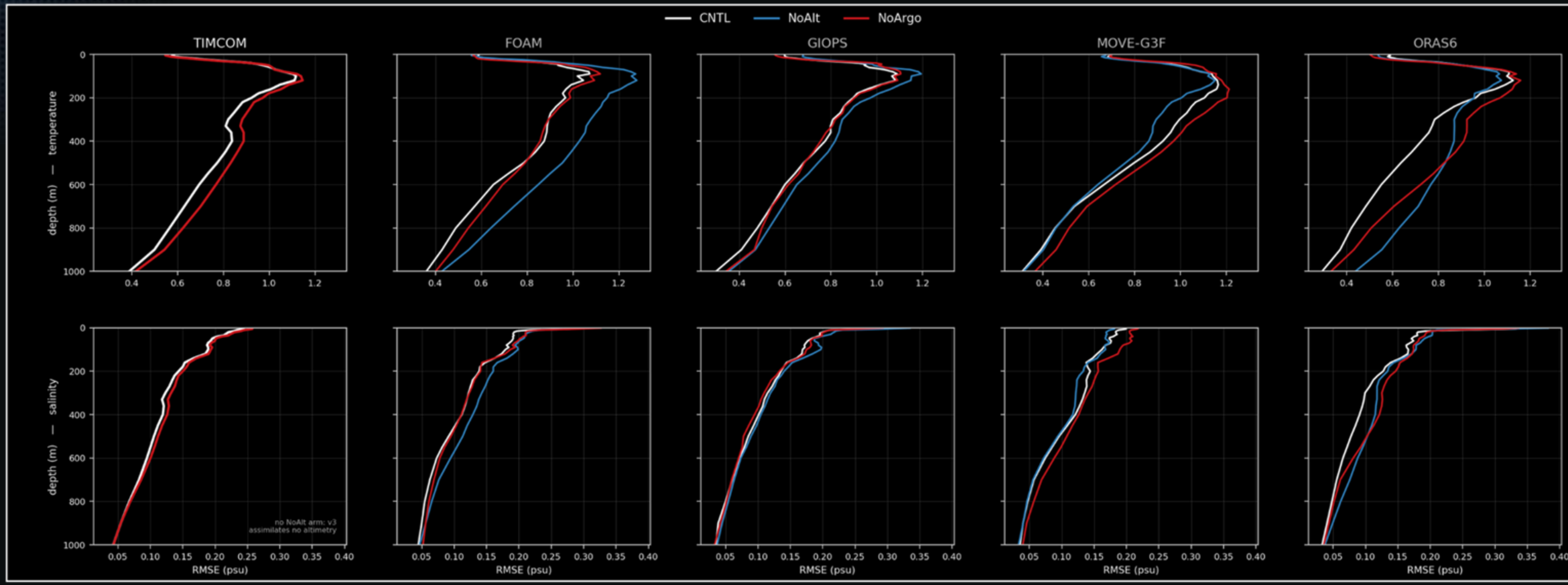
04

Two Sequently

Used two ensemble members and separated observation data due to limited static ensemble member data.

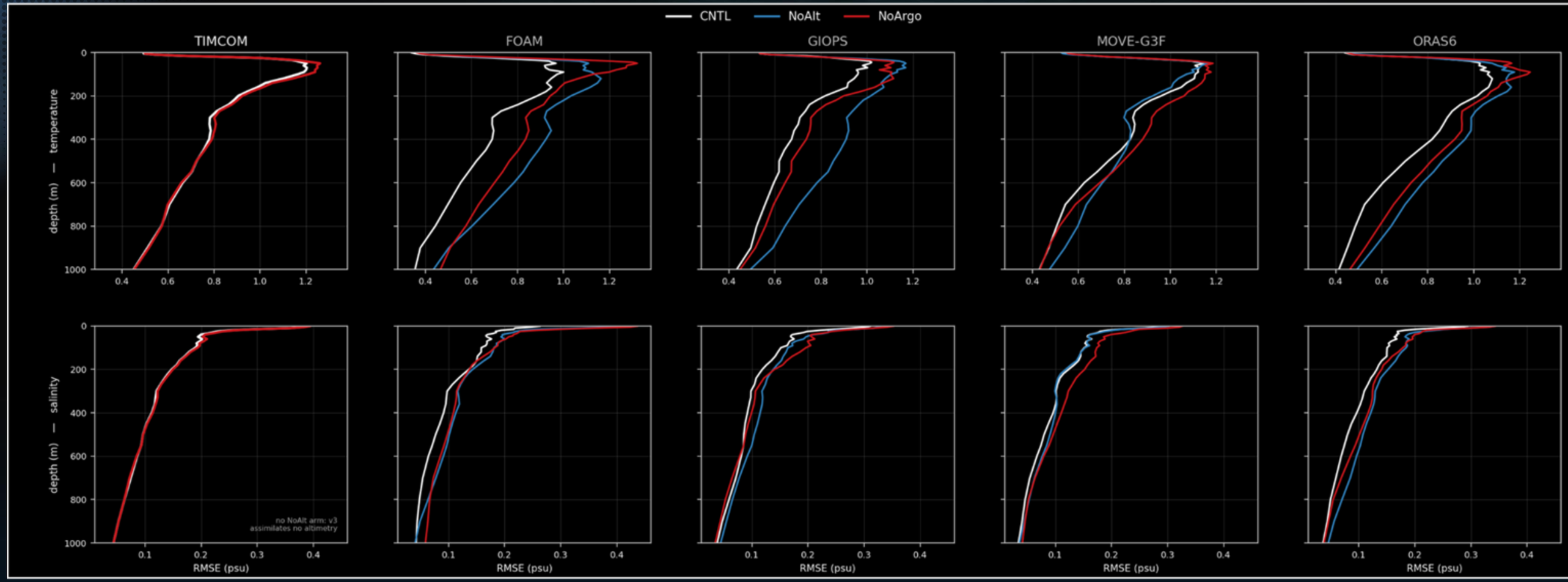
Thank You

SynObs OSE profiles, January 2020 — RMSE against withheld Argo (ArRef), 0-1000 m



- CNTL TIMCOM = NoAlt another SynOBS flagship model
- The pooled curves carry no uncertainty, and an arm-vs-CNTL claim requires per-day deltas with a confidence level.
- The systems are not comparable as the centre dental arms open the window already separated from the control group.
- Our two arms branch from one seed IC at the start and are still diverging at the end of the experiment.
- The shape of the TIMCOM panel should be read, not its amplitude.

SynObs OSE profiles, July 2020 — RMSE against withheld Argo (ArRef), 0-1000 m



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