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# Benefits of assimilating the SMOS SSS in the Arctic Ocean Reanalysis

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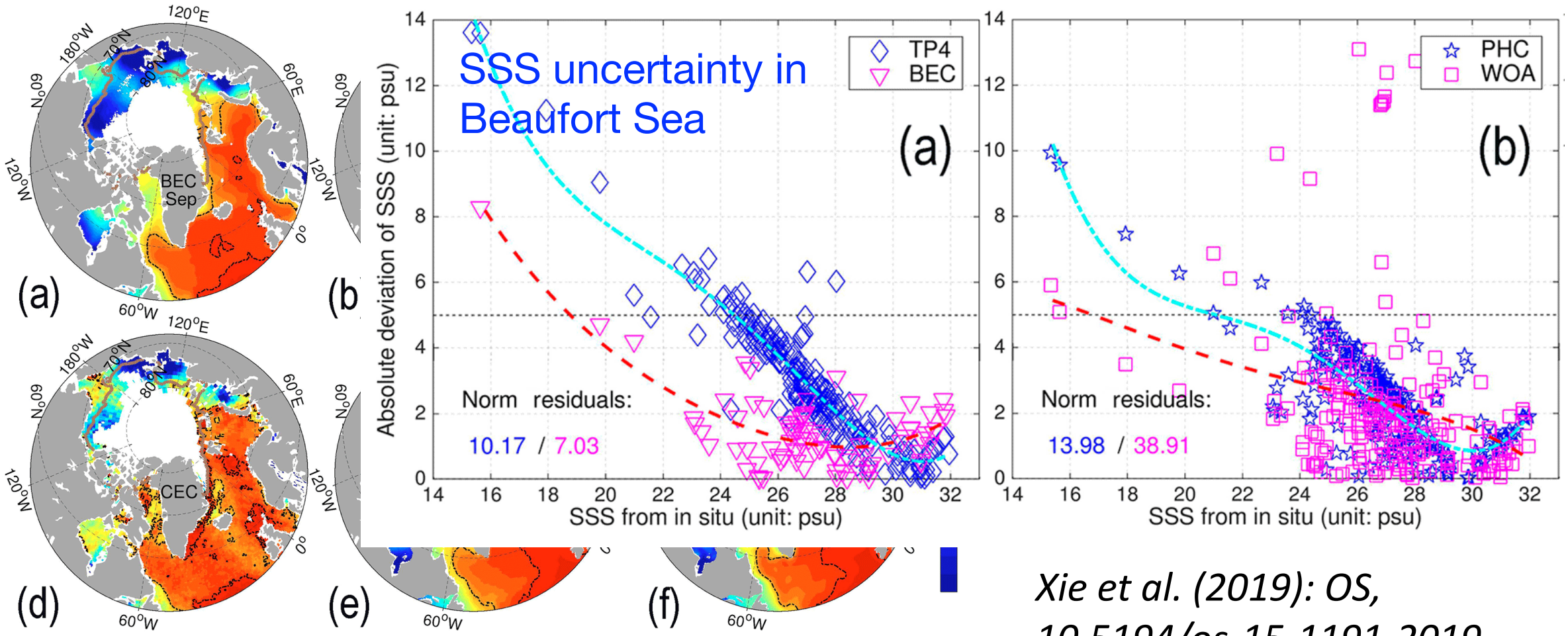
YOPP endorsed

# Outline

- Backgound of SSS in Arctic
- Assimilation experiments in TOPAZ and independent validation
- Impact analysis (monthly SSS; FWC)
- Conclusion and discussion

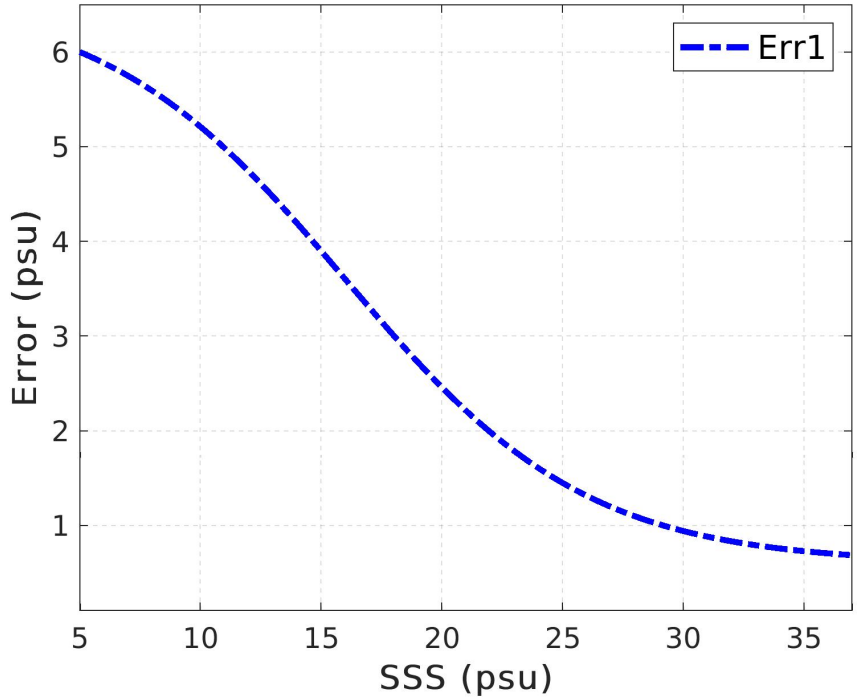



*Xie et al. (2019): OS, 10.5194/os-15-1191-2019*

# Assimilation Runs in TOPAZ

- **Exp0**: using the default assimiation setting in TOPAZ but no SSS assimilation.
- **ExpV2**: Exp0 + Arctic SSS Version 2 from BEC released in 2018
- **ExpV3**: Exp0 + Arctic SSS Version 3.1 from the ESA project: Arctic+SSS: http://dx.doi.org/10.20350/digitalCSIC/12620

**Setting**: DEnKF with 100 member; Assimilation all ocean and ice observations as in reanalysis.
**Time period**: July-Dec. 2016

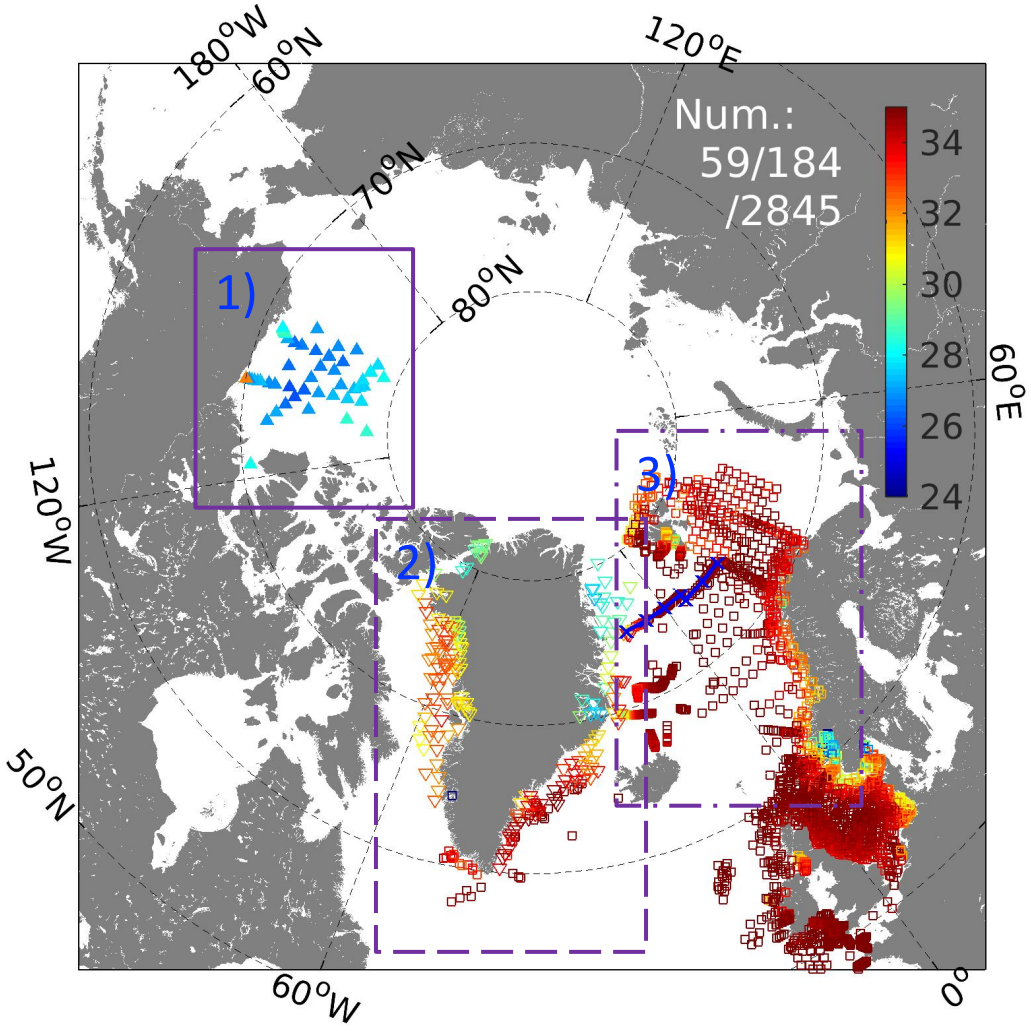



The observation error estimated for the SSS:

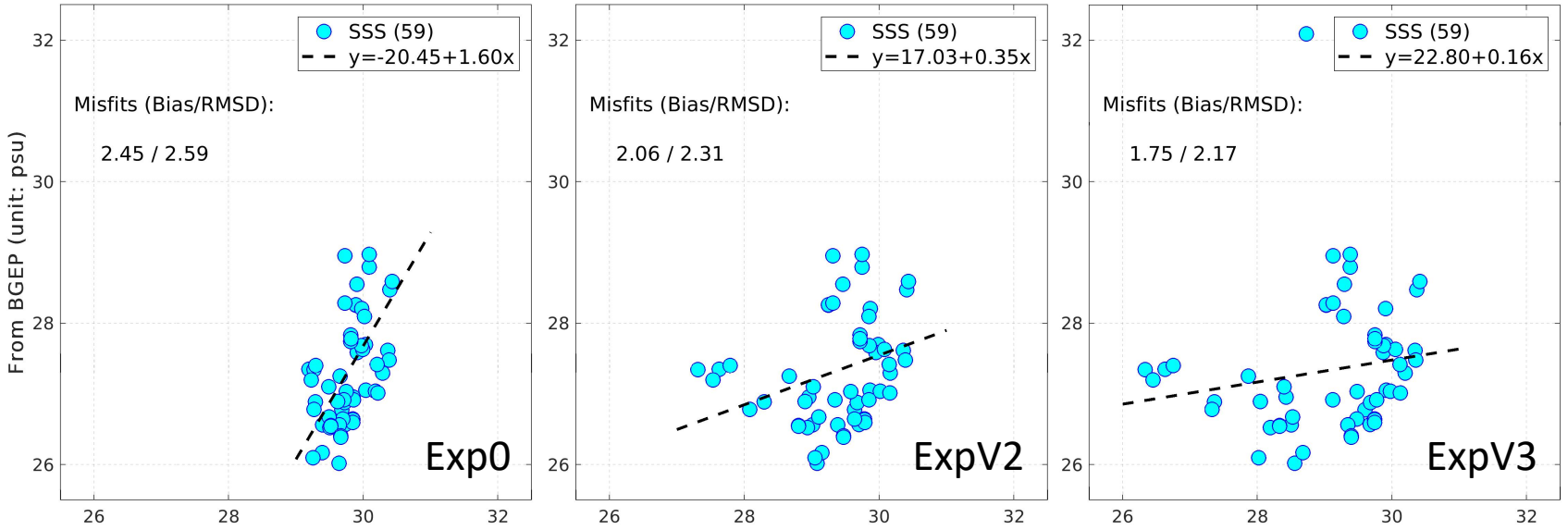
$$\boldsymbol{Err} = \max(Erro, 0.6 + \frac{6}{1+e^{(S-16)/5}})$$

# In-situ SSS for validation :

1) BGEP: Beaufort Gyre Experiment Project (WHOI)
2) Greenland project (NASA): OMG https://omg.jpl.nasa.gov/portal/browse/
3) ICES(https://ocean.ices.dk/HydChem/HydChem.aspx?plot=yes)

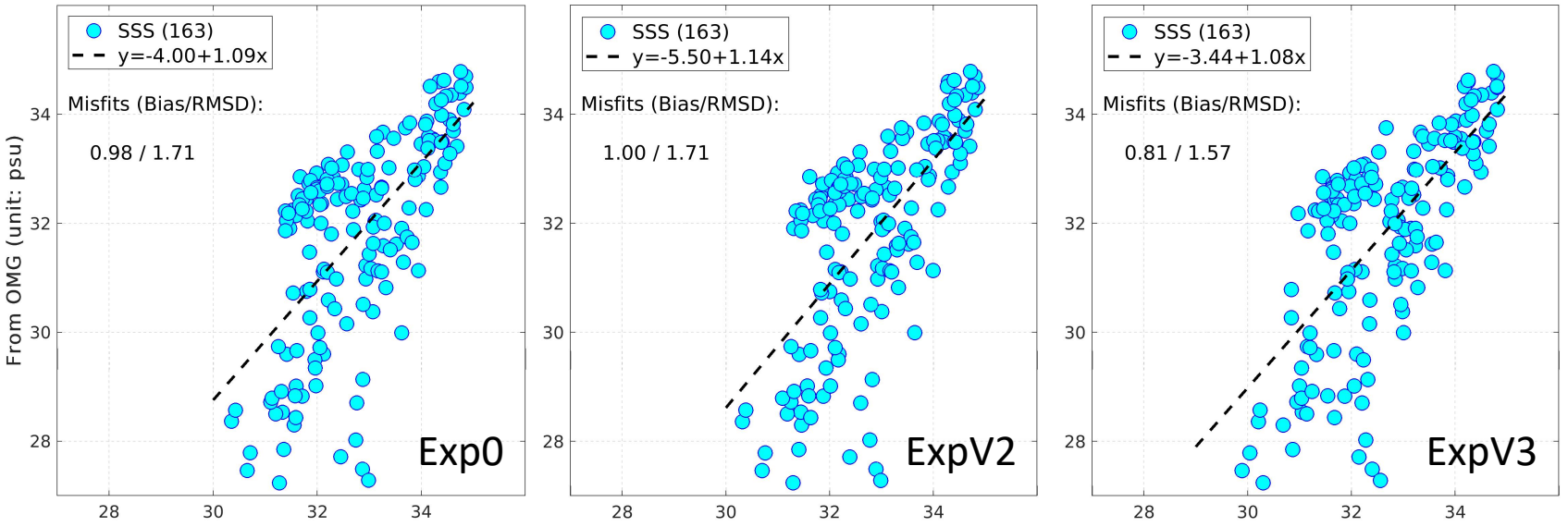


## 1) SSS in Beaufort Sea




- Salty biases are decreased by assimilating two products: 15.9%(V2) and 28.6% (V3);
- RMSDs also decreased with different skills: 10.8%(V2) and 16.2% (V3);

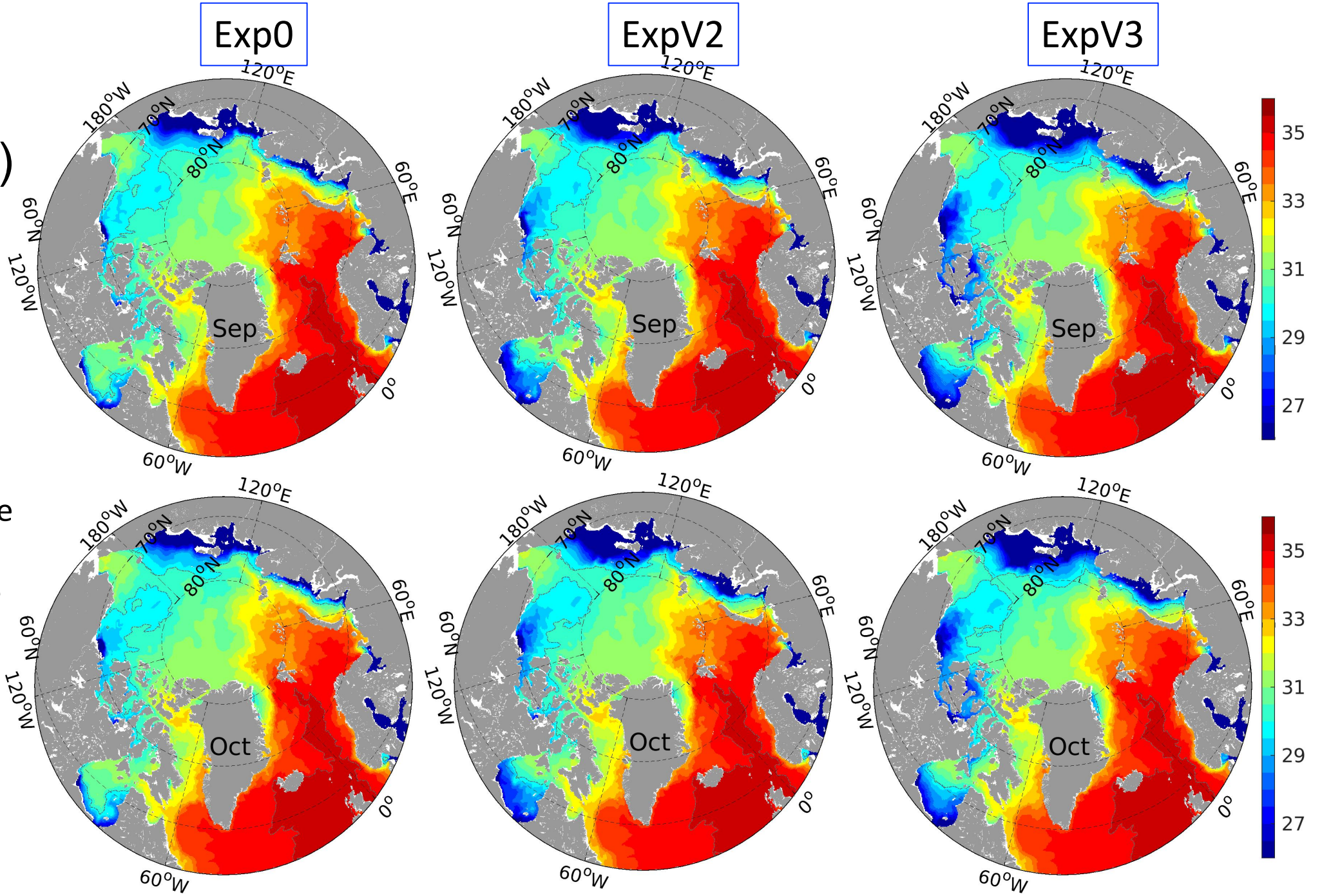
## 2) SSS around the Greenland Island




- Salty biase decreased by assimilating V3: 17.3% ;
- The RMSD also decreased about 8.2%, which indicates that V3 can bring more benefits.

# Monthly SSS (Sep and Oct)

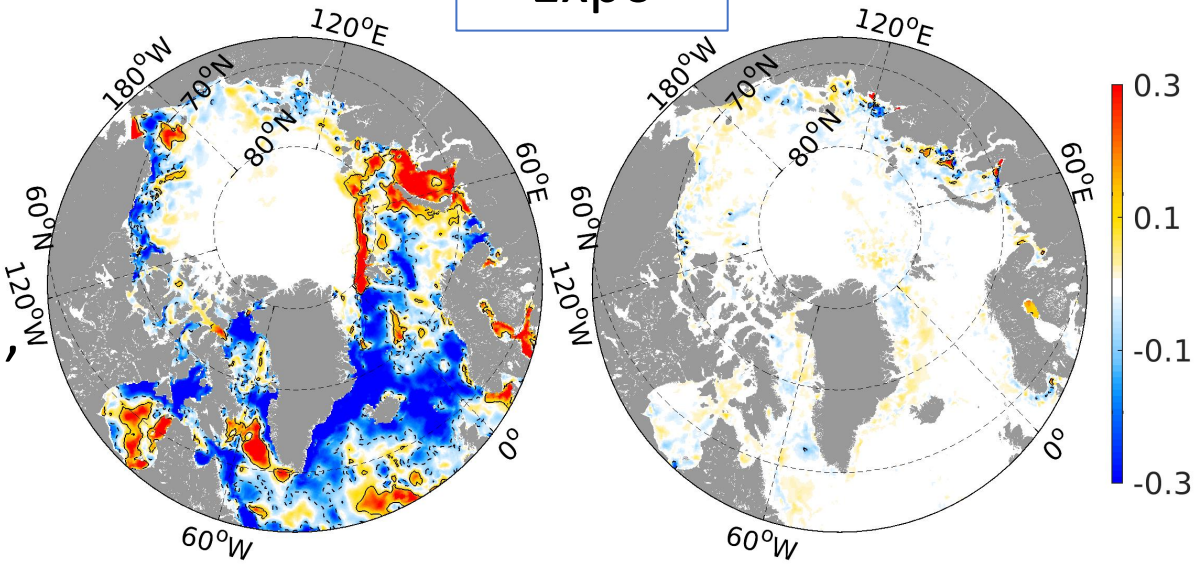
- Beaufort Sea: freshen further in ExpV2 and ExpV3
- October: more wide fresh water (<30 psu) appears at the east Greenland in ExpV3
- The Atlantic waters (35 psu) are quite similar in the runs



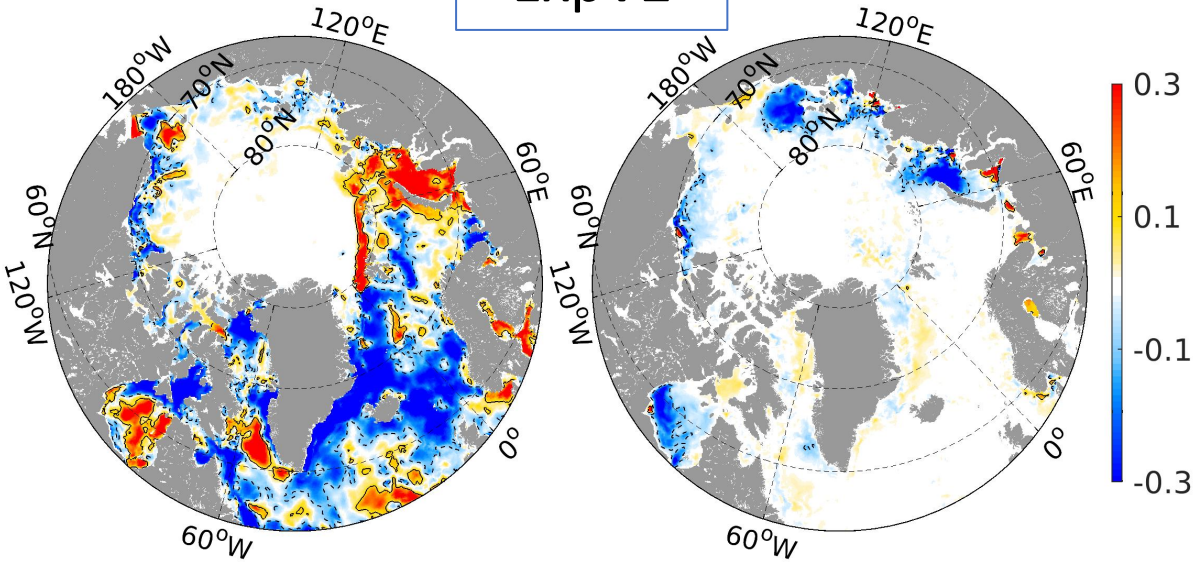
# Increments of Temp and Salt near surface (Jul.-Dec. 2016)

- SSS increments are very small in Exp0;
- V3 increases the SSS in Kara Sea and Laptav Sea, but V2 on the contrary;
- Solide (dashed) lines are 0.1 (-0.1) deg and psu respectively;

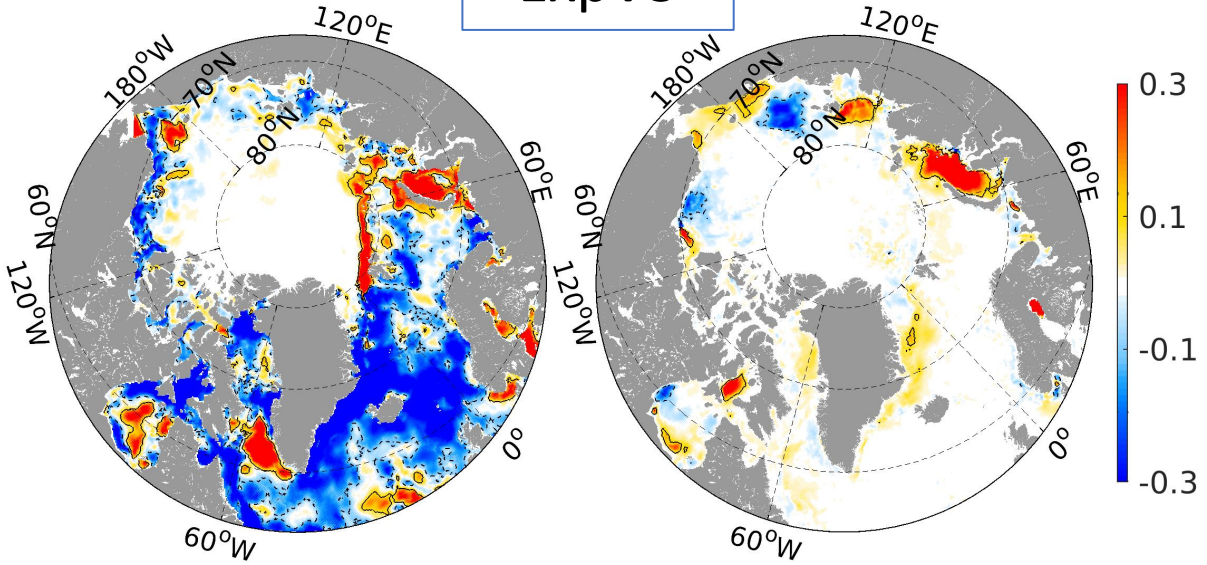
Exp0



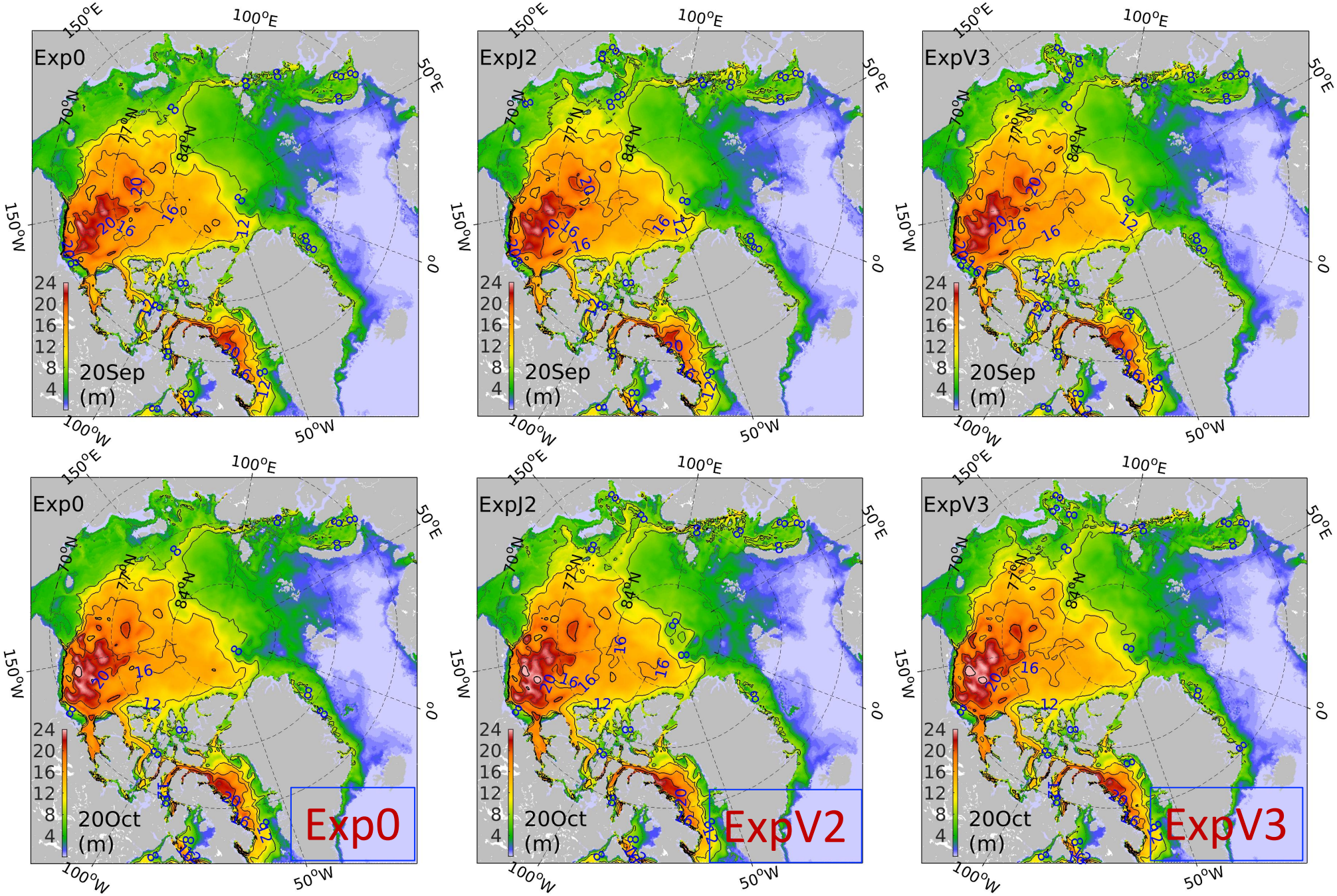

ExpV2




ExpV3

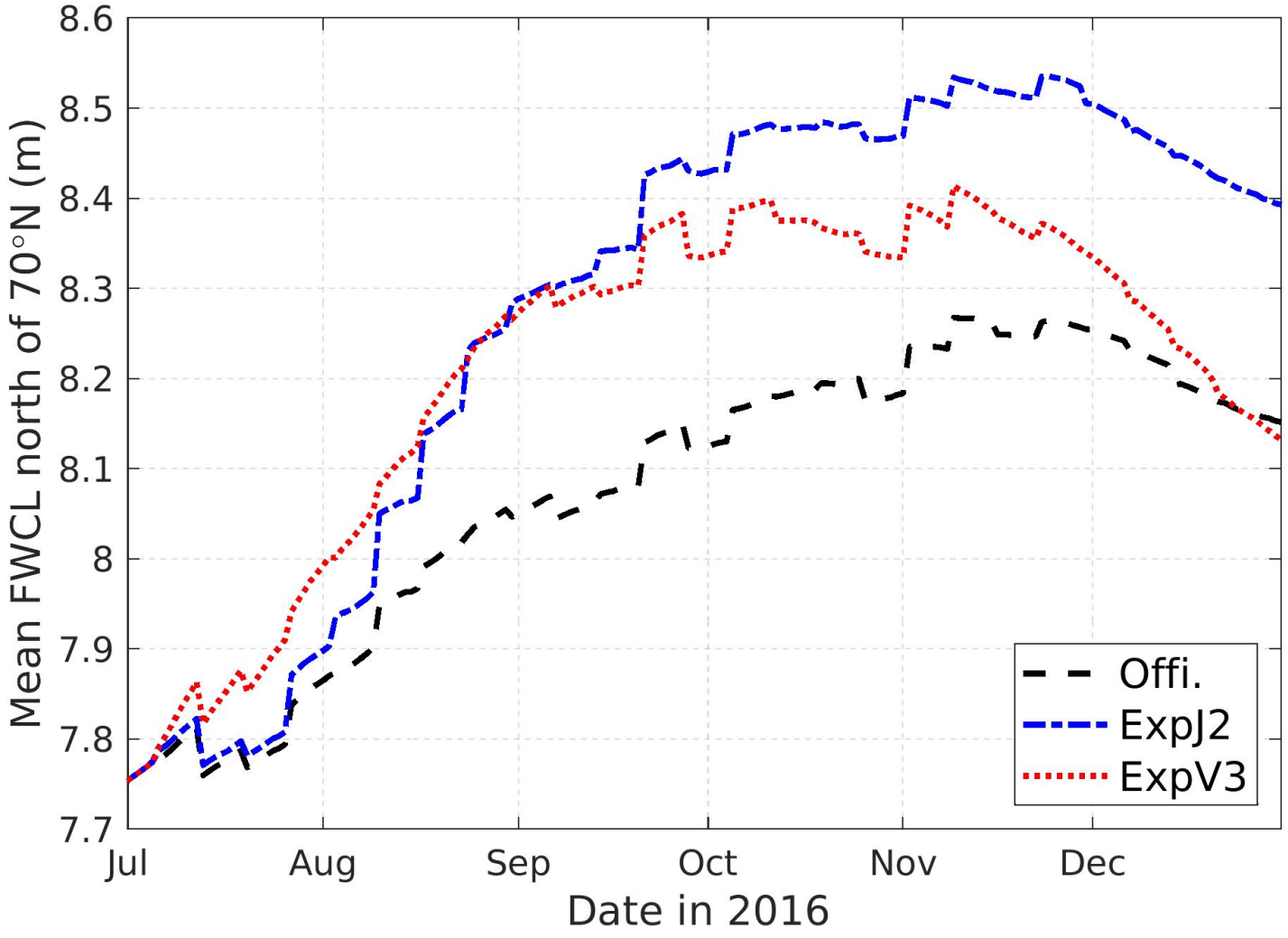


# Fresh Water Content (m)




- Interval of soli lines is 4 metedrs; The dashed lines are 4 and 22 meters respectively.

# Mean Fresh Water Content




**(>70N; unit: m)**

$$\mathrm{FWCL} = \int_{z2}^{z1} \frac{[Sref - S(z)]}{Sref} dz,$$

$S_{ref}$ =34.8
Integration depth; S≤34.8

(Proshutinsky et al., 2009)

# Summary

- A novel sea surface salinity data product from the SMOS satellite has been tested for assimilation in TOPAZ.
- Independt validation shows the Arctic SSS uncertainty can be reduced, but the V3 product of SSS clearly advantager than the V2. This data should therefore be fit for the CMEMS reanalysis.
- FWC analysis shows the SSS assimilatin can tune the FWC seasonal variance, but a longer run will help to understand its full impact.