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Recommendations from working group 1

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Resolution

- The observing network poses a constraint on the resolution of DA systems, as we cannot constrain the unobserved scales. However, resolving important physical processes is important in many regions such as in Western boundary currents, as well as for having realistic variability in an ensemble. Model configurations that include targeted resolution increase in dynamically active regions or the use of two-way nested model systems could be beneficial.

- The use of OSSEs and OSEs is recommended to understand how well the existing observing networks constrain the models and what we need to properly constrain them. Using different systems for OSSEs and OSEs can be useful to differentiate effects that are specific for a given model system from the effects that are directly related to the observations.

- As we move towards higher resolution, novel/emerging observation platforms that sample finer scales may become more useful to the DA system. Observations that sample coarser scales (e.g. altimetry, PMW) might need different treatment in a high-resolution DA system than before.

- Validation of the DA products should account for the error of representation associated with the observations used.

Best practices

- Clear distinctions should be created between the producers and users of reanalyses. Users might be better bias-correcting reanalyses for their own specific needs

- Early collaboration between reanalysis producers and modellers is vital as reanalyses provide vital information on model deficiencies. Analysis increments are a powerful tool to look at such systematic errors.

- Assessment of reanalyses should be consistent with the specific goal of the reanalysis (best estimate of any single state versus best estimate of climatology/trends). Reanalyses metrics should be specific to the purpose they were created

Infrastructures

- A closer link between academic and operational environments is seen as beneficial for many aspects: training courses should be available for what will be used in research and operationally. Specific scientific programming (e.g. HPC/MPI) might also be coordinated together. There exist good examples (UKMO models, OpenIFS) that could be extended to DA systems.

- Realistic model setup that can be affordable for DA research applications, mimicking real-world problems (e.g. for coupled DA) need further investments. Prioritizing resolution versus domain size versus observation availability versus complexity (e.g. SCMs, OCE+ABL, ATM+MLM, etc.) may depend on the specific problem, yet common benchmarks could be useful.

- Shared procedures (QC, OBSOPER, etc.) with available open-access code can ease the use of realistic DA systems also in academic environments and reduce redundancy of works in operational institutions

Methodology and coupled DA

- Tangent linear and adjoint codes of ocean models should be comprehensively assessed to document which processes can and cannot be represented and the error growth rates of the tangent linear approximation. This is particularly relevant for high horizontal and vertical resolution models.

- 4DVar capabilities should be developed for those systems that currently rely on 3DVar.

- More information should be extracted from existing products, such as using existing ensembles to inform hybrid background error covariances, and sharing of observation space diagnostics with data providers.