Cycling prototypes: vehicle for collaboration and development of the MRW/S2S application

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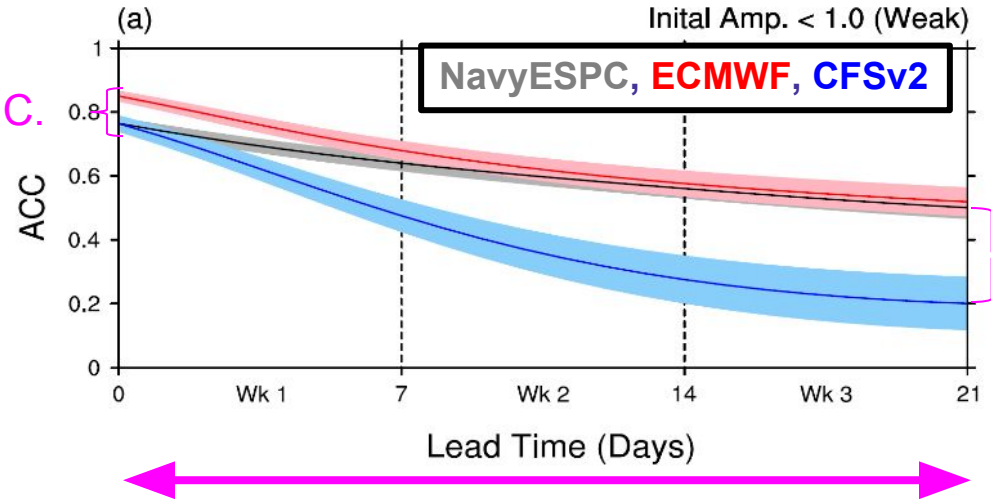
MRW/S2S prediction

MJO (ROMI 1) predictability

ECMWF has better IC.



Modern models have comparable skill at week 3.

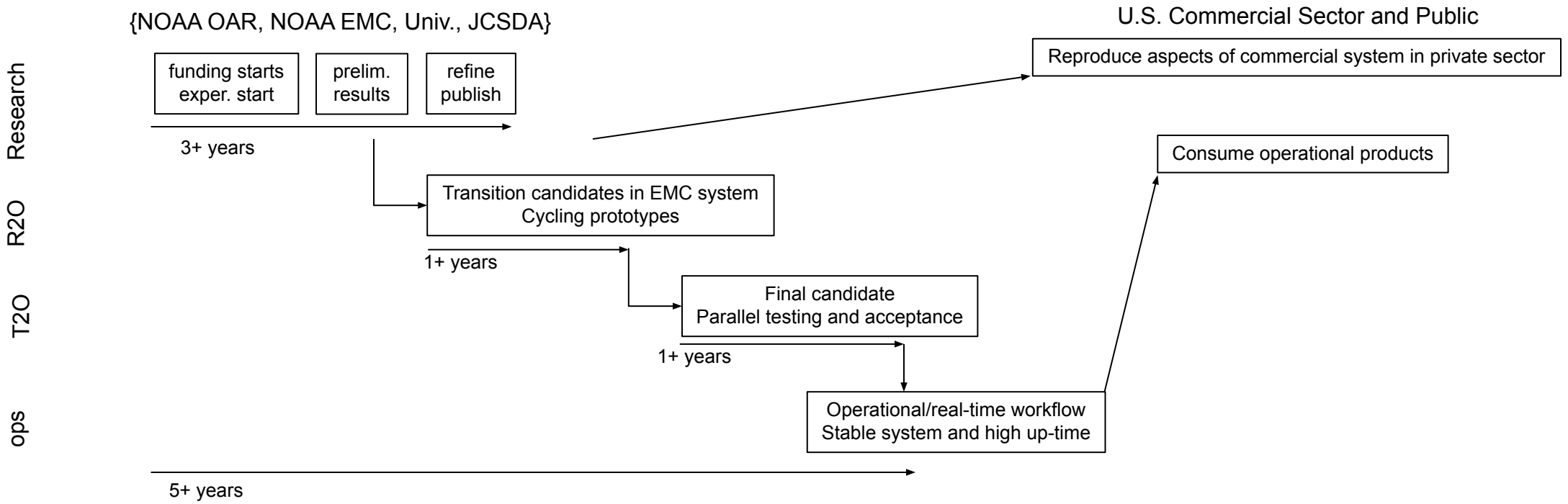
Initial conditions quality

Forecast model quality

- Skill of UFS MRW/S2S equally depends on forecast model and data assimilation (I.C.) quality.
- So far development focused on the improvement of the forecast model (coupled prototype 1-8).
- This talk is about bringing forecast model development and DA together.

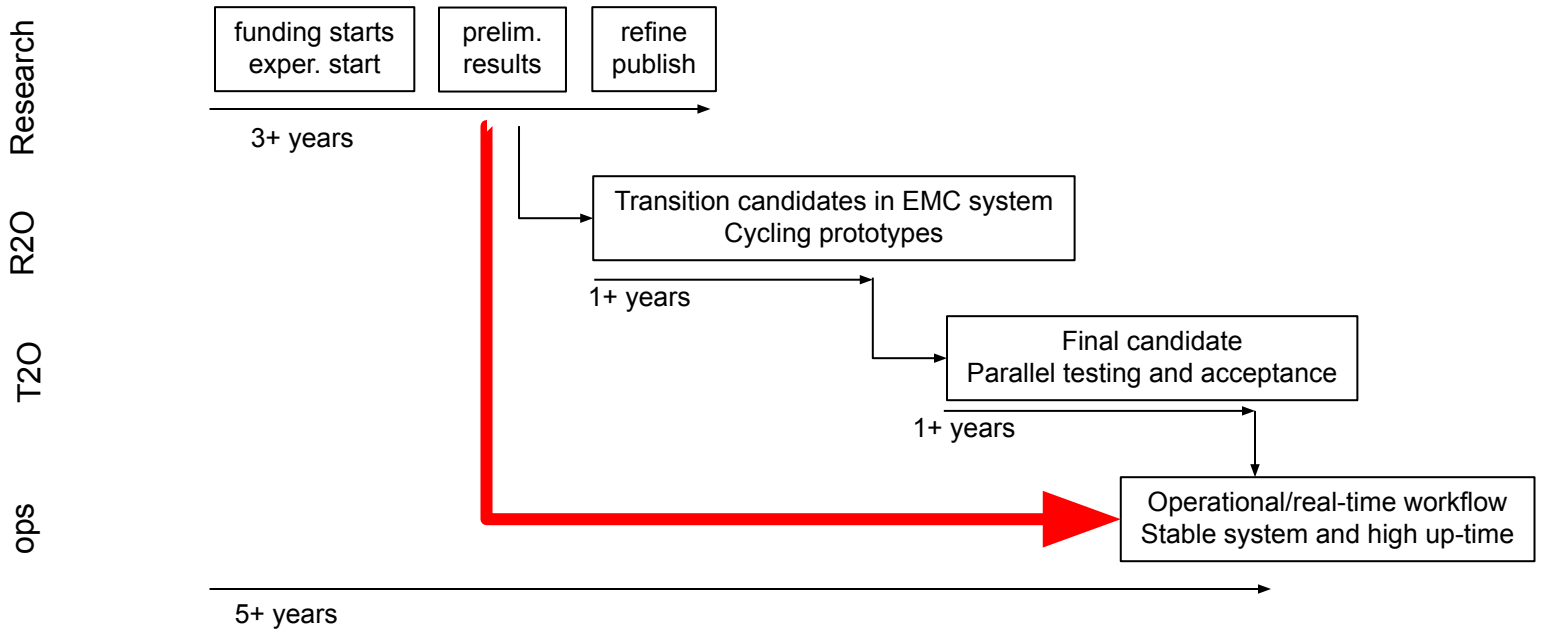
Janiga et.al. 2018

From research to operations



From research to operations

{NOAA OAR, NOAA EMC, Univ., JCSDA}



Goal:

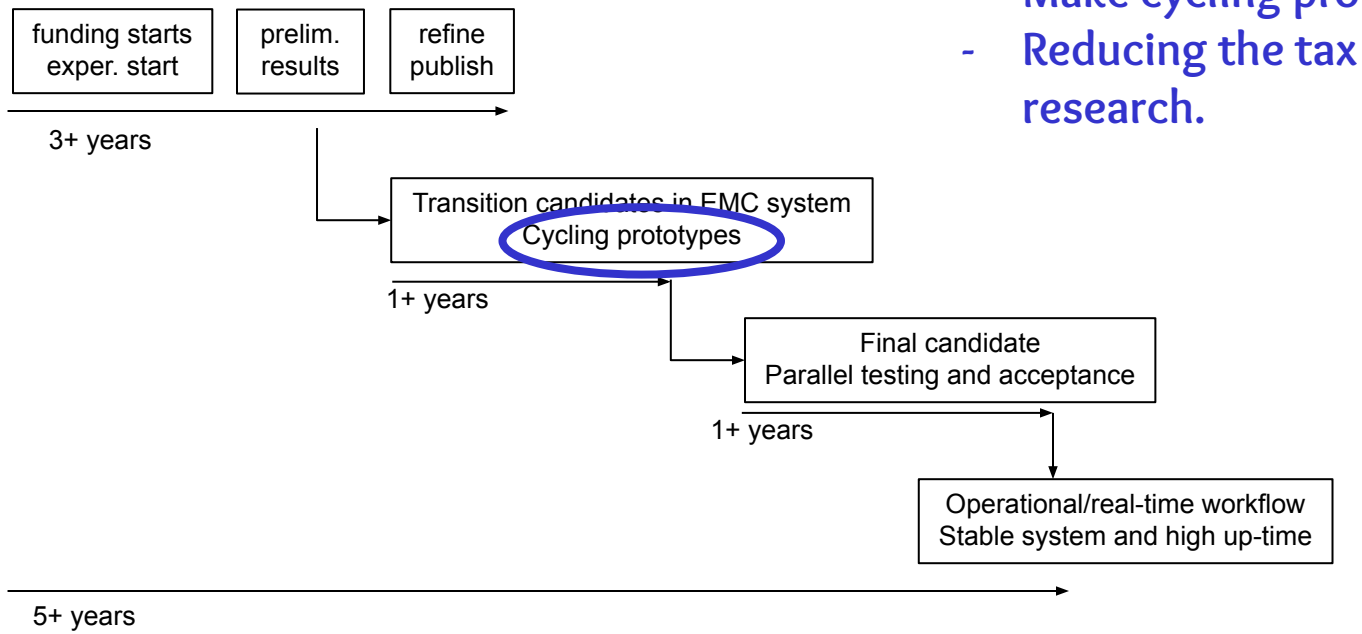
- Reproduce science advances in operations
- Shorten the transition lag

(3-5 years NOAA, 1-3 years ECMWF)

From research to operations

Research

U. Oklahoma	Custom workflow, outdated versions of GSI and FV3
JCSDA	Custom workflow, divergent version of FV3, MOM6, SIS
NOAA EMC	Global workflow, top of develop for GSI and UFS
NOAA OAR	Custom workflow, Lagged version of develop for GSI and UFS



Challenges:

- Research has different starting points and workflows.
- Reproducing science across organizations and platforms.
- High tax of running pre-operational configuration in research (complexity, cost, expertise).

Suggested solution:

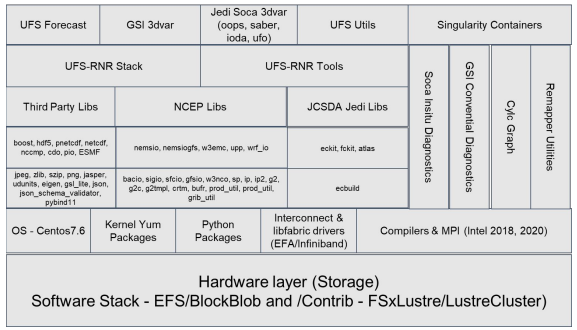
- Make cycling prototypes available to research community.
- Reducing the tax of running pre-operational workflow in research.

Definition: cycling prototype

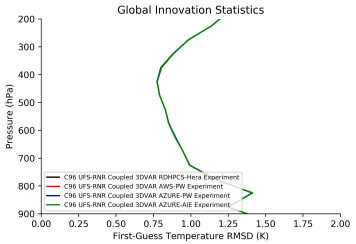
- Scientifically valid configuration for all major components: UFS, DA.
- Tagged version of all major executables: UFS, GSI, SOCA, land DA.
- Reproducible software stack to compile and run major executables.
- Observational data and I.C. to run a valid experiment.
- Reference solution for a known period of time.

Example of cycling prototype: UFS RnR

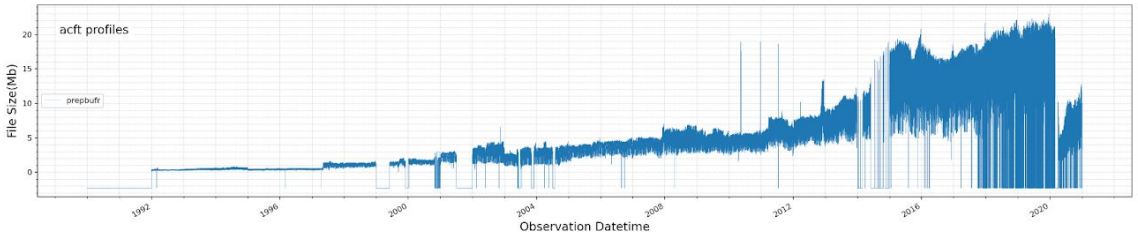
(a) Software stack for cycling DA (https://github.com/NOAA-EMC/hpc-stack)



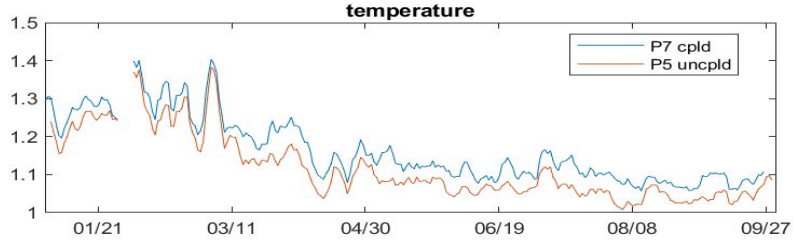
(b) Reproducibility on hera, AWS, AZURE



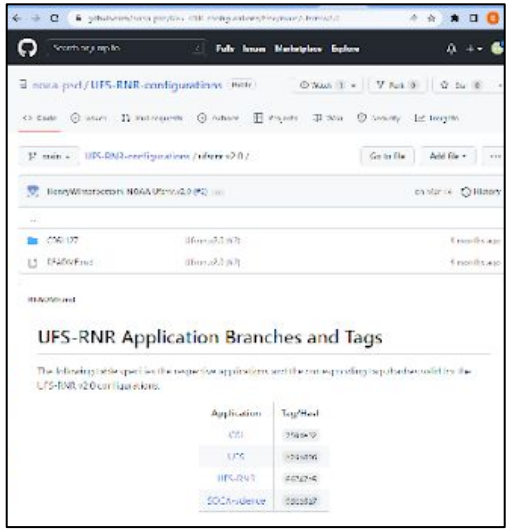
(c) Observational record (aircraft) 1992-2021



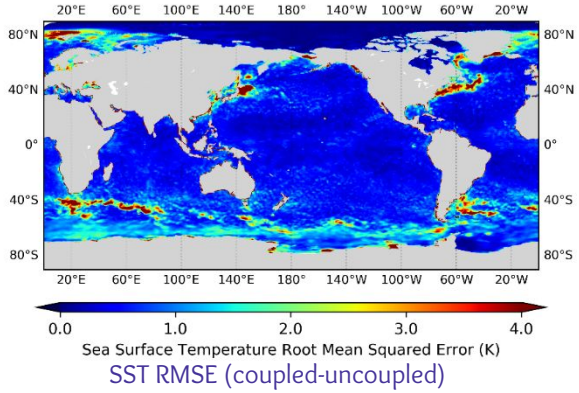
(d) Reference scores for coupled and uncoupled run



(e) Tagged repos with reference configs



(f) Scientific evaluation of the results



- NOAA PSL has developed coupled cycling system using:
  - UFS coupled model at 1° p7c physics.
  - GSI 3DVAR + GSI GETKF
  - SOCA 3DVAR + SOCA LETKF.

Cycling prototype: vehicle for structured development and collabortion

Suggested sequence of prototypes for GFSv17/GEFSv13

Now

CP0: coupled UFS P7c (FV3, MOM6, CICE), 1°, 3DVAR

CP1: Reproduce CP0 using global workflow + UFS P8c (+ WWIII)

CP2: Upgrade resolution (1/4°) , + all sky assimilation, + land DA

CP3: + ensemble, + hybrid DA at 1°

CP4: Upgrade resolution (high-res control + ~1/4° ensemble)

CP5: Computational optimization.

CP-Final: Parallel testing

2024

Role of EPIC: infrastructure for running of the basic components

- HPC stack;
- Nightly testing of components on NOAA platforms:
  - RDHPC: Hera, Orion, …
  - Parallel Works: AWS, AZURE, GCP
- Basic components needing testing (includes tagged versions with specific configurations):
  - GSI, JEDI (soca, fv3-jedi), UFS
- Providing archive of:
  - observations and initial conditions (collaboration with PSL).
  - Fixed files (orography, coastlines, look-up tables, …)

End