DTC Update on Hurricane Supplemental Projects

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Outline

- HAFS Infrastructure – Evan Kalina
- HWRF Physics in HAFS – Man Zhang

HSUP Resources

$135 K (PoP: Jul 2019-Sep 2021)

HAFS Infrastructure

PI: Evan Kalina

Deliverables:

Establish an authoritative UFS workflows repository in GitHub with CROW code as the starting point (HU 12/2019)

Review the design and implementation of CROW with community partners (HU 06/2020)

Demonstrate that CROW or a CROW alternative can interact with the Common Infrastructure for Modeling the Earth (CIME) for building and running simple forecast model configurations (HU 06/2020 → 09/2020)

Plan and document the design of the transition-to-operations workflow for the UFS hurricane application based on collected requirements and review with technical and scientific partners (HU 09/2020 → 12/2020)

Demonstrate a workflow for a HAFS configuration that is suitable for simplified benchmarking that is part of a transition to operations, including the ability to do cycling without full DA (HU 06/2021 → 09/2021)

CROW review report

- Shared with EMC partners, Hurricane app leads on June 8.
- Posted to the DTC website on June 24: LINK
- One anticipated outcome of report is to facilitate a decision by EMC on whether to use CROW in HAFS
  - Suggest decision by September 1, preferably sooner.
  - A delayed decision will make it harder to complete the next milestone:

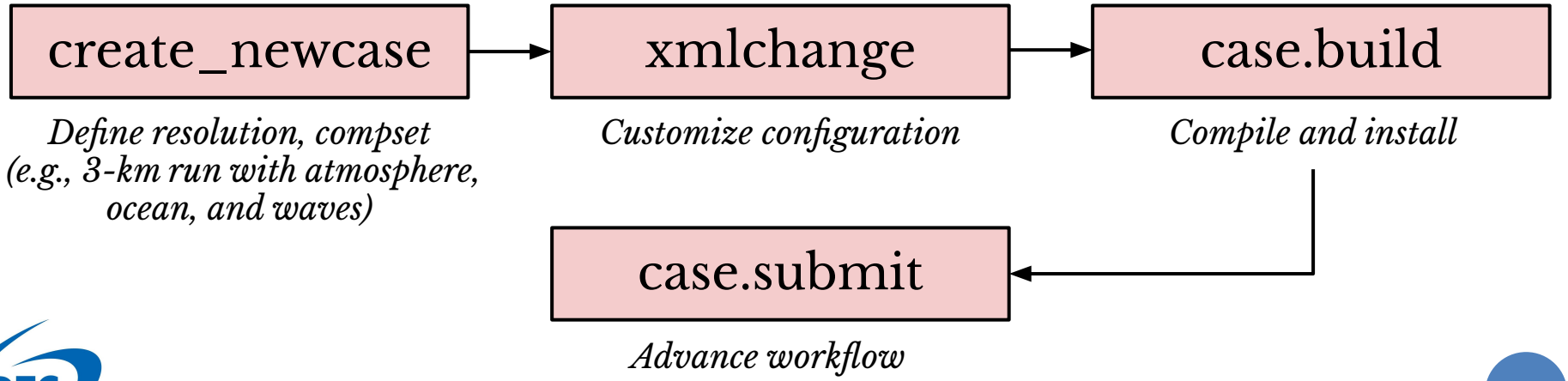
"Demonstrate that CROW or a CROW alternative can interact with CIME for building and running simple forecast model configurations."

Motivation for adding CIME to HAFS

- Make HAFS workflow even more friendly to users, developers
  - Add hierarchical testing capabilities
    - Data models: Replace an active model component with a canned dataset
  - Make it easier to port HAFS to new platforms
- Look for opportunities to unify with other UFS applications
  - UFS Medium-Range Weather App public release uses CIME

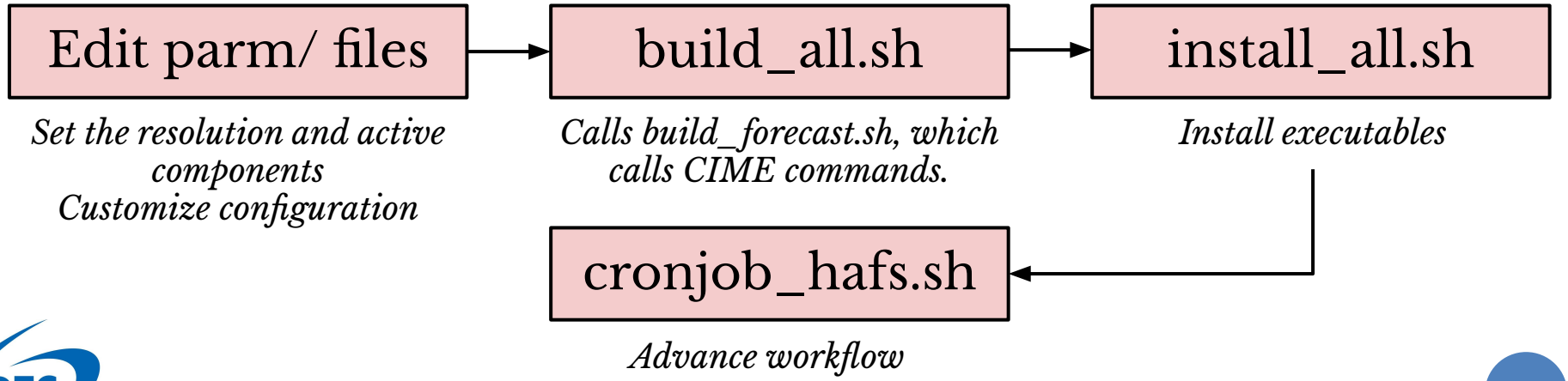
Two design options for CIME in HAFS

- Option 1: CIME replaces the current HAFS workflow with something similar to the UFS MRW application workflow
  - Users would directly run the CIME commands to configure, build, and run HAFS, including the VI and DA steps.
  - Instead of parm/ files, the xmlchange command would be used to customize the configuration.
  - Steps run by the user:



Two design options for CIME in HAFS

- Option 2: CIME is driven by the current HAFS workflow.
  - build_forecast.sh calls CIME
  - CIME reads the files in parm/ to configure the forecast
  - CIME only builds the forecast executable
  - HAFS workflow submits the CIME-built forecast executable
- Goal: Allow user to interact with CIME directly if they want
- Otherwise, the user runs the existing HAFS build/workflow:



HWRF Physics in HAFS

Man Zhang, Mrinal Biswas, Grant Firl, Ligia Bernardet, Mike Ek, Dom Heinzeller

EMC Collaborators: Chunxi Zhang, Bin Liu, Eric Aligo
Federal Manager: Avichal Mehra

Deliverables:

- HWRF F-A, saSAS, and RRTMG parameterizations in CCPP (Jan 2020)
- HWRF Physics Suite Test Plan (Apr 2020)
- Successful HAFS v0.a runs using the HWRF suite (Apr 2020)
- DTC HWRF physics test on Orion (Mid-Jun 2020)
- Transitioned hwrf-physics branch from NCAR to hafs-community Github (Jun 2020)
- **Presented results in the first UFS Users' Workshop (July 2020)**
- Final report on test results (Aug 2020)-coming soon

HSUP Resources at NCAR
$86K (PoP: Aug 2019-July 2021)

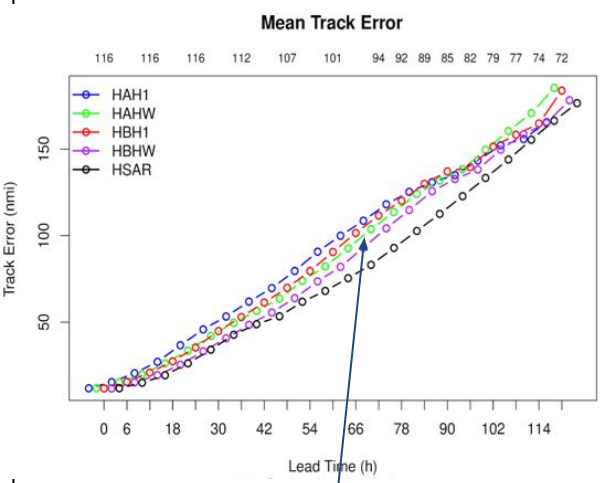
HSUP Resources at GSL
$62 K (PoP: Aug 2019-Jul 2021)

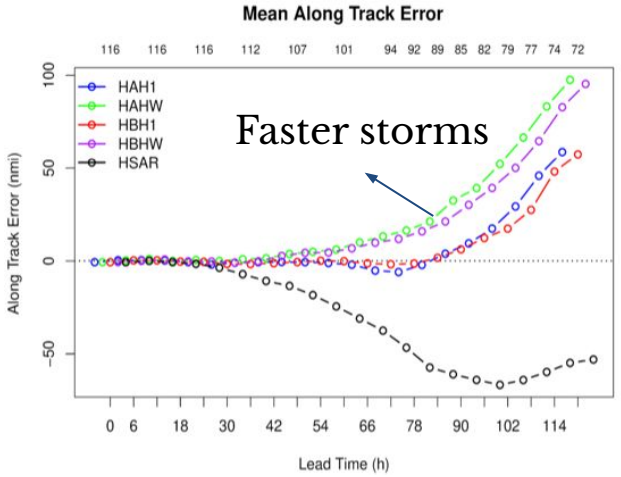
Overview of HWRF Suites in CCPP

Scheme/Suite	HWRF	HAFS_p0.1	HSAR
Exp.	HAHW/HBHW	HAH1/HBH1	HSAR
Microphysics	Ferrier-Aligo with separate cloud species advection	GFDL	GFDL
PBL	K-EDMF unified w/ HWRF namelist settings	K-EDMF unified w/ HWRF namelist settings	k-EDMF w/ HWRF namelist settings
Deep/shallow CU	saSAS with HWRF settings on in all domains	saSAS with GFS settings on in all domains	off
Radiation	HWRF-RRTMG	GFS-RRTMG	GFS-RRTMG
Surface layer	GFDL	GFS w/ HWRF namelist settings	GFS w/HWRF namelist settings
LSM	HWRF-Noah	GFS-Noah	GFS-Noah
Orographic GWD	off	off	on
Non-stationary GWD	off	off	off
Ozone	NRL_2015	NRL_2015	NRL_2015
Water Vapor	NRL_2015	NRL_2015	NRL_2015

- The implementation of ***HWRF suite*** into HAFS via CCPP is a collaborative effort between DTC, GSL and EMC
- ***HAFS_p0.1 suite:*** UFS MRW physics suite with Hurricane specific modifications
- ***HSAR suite***: the 2019 EMC HAFS real time physics suite (using an old code base)
- Yellow highlights indicate aspects that differ between the suites

Overall Performance



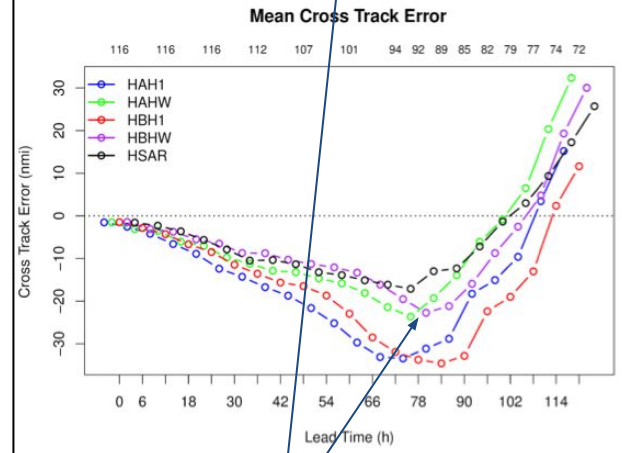


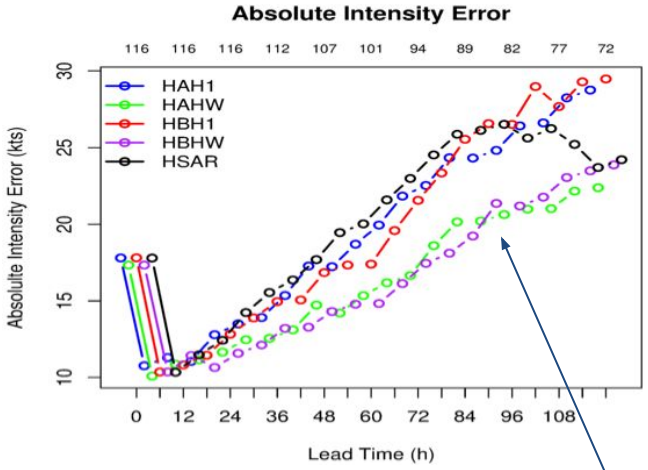
Faster storms

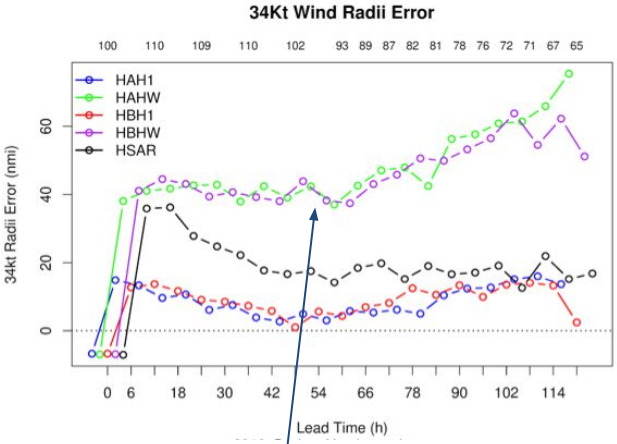
2019 AL Priority Storms

Storms	First cycle	Last cycle
05L Dorian	2019082406	2019090718
09L Humberto	2019091212	2019091906
13L Lorenzo	2019092212	2019100206

	HWRF	HAFS_p0.1
SAR(v0.a)	HAHW	HAH1
NEST(v0.b)	HBHW	HBH1







Improved mean/cross track error

Less intensity error

Bigger storms?!

See more results in DTC final report

HAFS Activities at DTC

- **HWRF Physics T&E in HAFS**

  Results of the first exercise with HWRF physics in HAFS are promising:

  - Better mean track forecast than HAFS_p0.1 suite, especially cross track error in both SAR and globnest configuration
  - Improved intensity forecasts compared to HAFS_p0.1 and HSAR
  - Excessive size of the storms

- EMC is conducting additional testing/tuning in a larger and more diverse sample size to realize the benefits of this suite
- Shaowu Bao of CCU is investigating the UPP GOES-R results of HWRF physics test through DTC visitor project

HAFS Activities at DTC

- **HWRF Physics R&D in HAFS**

  CCPP team and EMC takes over the job of debugging the HWRF physics to get them into the master. *dtc/hafs-develop* branch was created at NCAR Github repositories with several upgrade and bug fix made by DTC and EMC:

  - ***fv_regional_bc*** module: initialize FA cloud species and add a cloud physics auto conversion routine for FA mp scheme
  - Relax the ntrac> ntracers limitation in ***external_ic*** module
  - Fix a dimension bug in ***delz*** in subroutine ***neg_adj2***
  - Further optimize the use of FA cloud species in ***fv_dynamic*** module
  - Fix a bug in CCPP hwrfsas

A new PR to HAFS compatible with the latest UFS is on the way