# Hurricane Analysis and Forecast System Development: Future Priorities

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# HAFS Development Approach



| | |
|---|---|
| Basic Research | |
| READINESS LEVEL | |

UFS Community

Base
HFIP
EPIC
JTTI
HSUP
…

UFS-R2O
Project

NSF
DOE
NASA
Private
Sectors
…

Transition to Operations

Operational systems
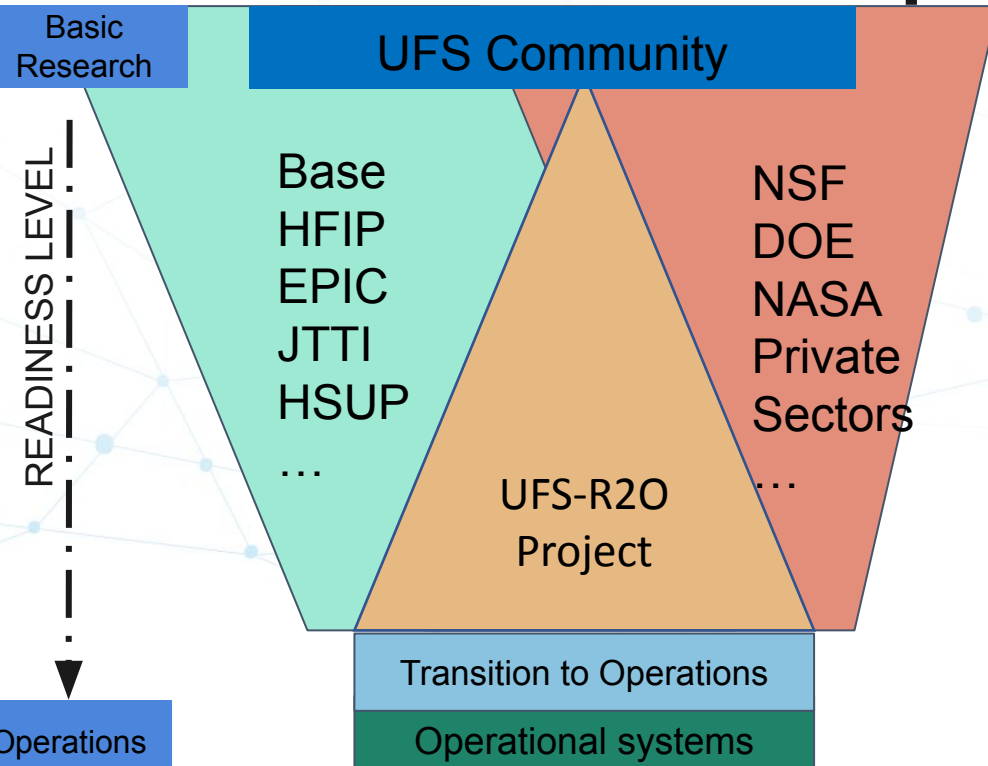
Operations

UFS-R2O Project and its applications follow the same approach:

o Develop innovations into operations
o Ensure lower Readiness Level (RL) research in the R2O pipeline
o Leverage other research and development programs and projects
o Transfer high RL research into operations

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# HAFS Development Priorities: After 2023 IOC

- **Moving nest**
  - Multiple storms
  - Flexible nesting refinement
  - Mass adjustment for fine topography consistency in blending zones
  - Code optimization
- **Data assimilation**
  - New data ingestion
  - Self-cycled DA
  - Weakly Atmosphere/Ocean coupled DA
  - JEDI transition
- **Ensemble capabilities**
  - Stochastic physics ensemble capability
  - Ensembles on the Cloud (HERC project)

- **Physics**
  - PBL for TC application
  - NOAH-MP transition and evaluation
  - CP upgrade, transition, & evaluation
  - Microphysics parameterization upgrade
- **Ocean and wave model transition**
  - HYCOM to MOM6 transition
- **Products**
  - Ensemble products
  - Product fidelities
  - 7-day forecast products
- **Workflow**
  - Improve efficiency
  - Add more research options

# HAFS Development Priorities: Future Innovations

- **Moving nest**
  - Global moving nest
  - Telescopic moving nest for LES capability
- **Data assimilation**
  - AI/ML technology for DA
  - Atmosphere/Ocean coupled DA: strongly vs. weakly
  - All-sky radiances: CRTM vs. RRTMG
  - New DA methodology: scale-aware, particle filter, etc.
  - DA and physics parameterizations interaction

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# HAFS Development Priorities: Future Innovations

- **Observations**
  - New observations
  - Observation strategy
- **Ensemble**
  - Initial condition perturbation
  - Ensemble for DA
  - Ensembles on the Cloud (HERC project)

- **Physics**
  - AI/ML for physics parameterizations
  - Sub-kilometer physics
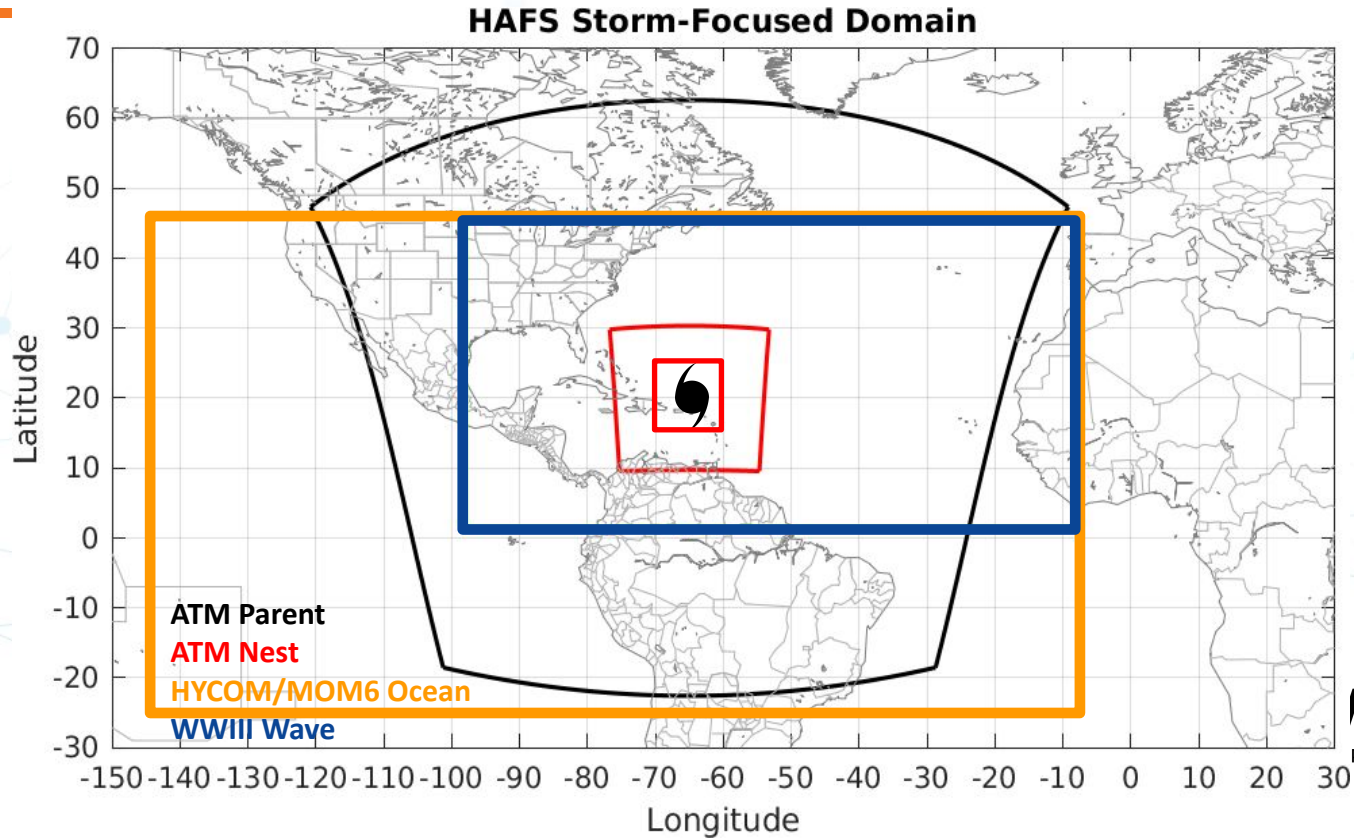  - Physics interactions
- **Ocean-Wave-Atmosphere coupling**
  - Three-way coupling
  - Coupling strategy
  - Ocean and wave model physics
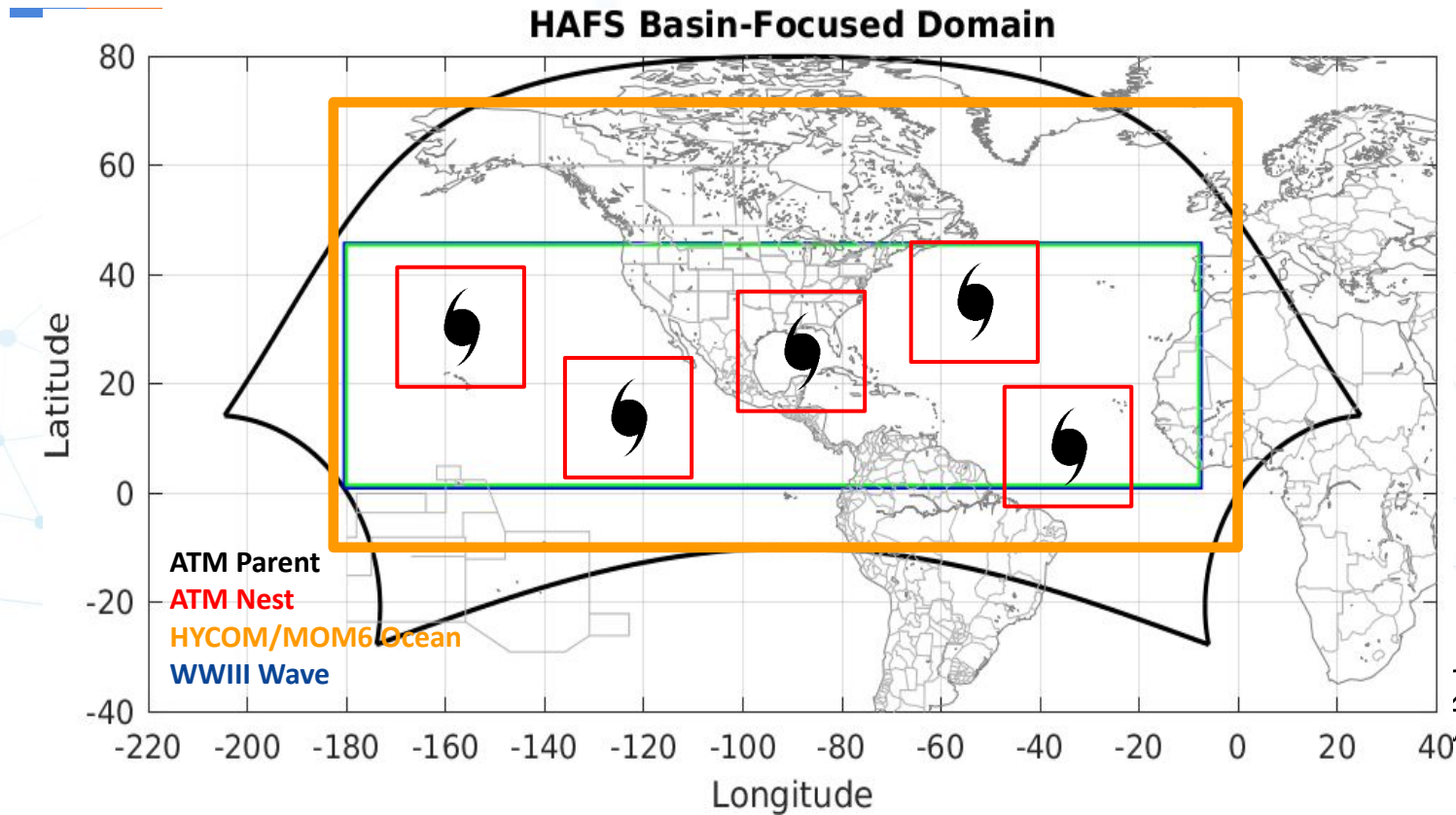  - Ocean and wave model initialization

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# Telescopic Nest Capability



HAFS Storm-Focused Domain

ATM Parent
ATM Nest
HYCOM/MOM6 Ocean
WWIII Wave

# Multiple Moving Nest Capability



HAFS Basin-Focused Domain

ATM Parent
ATM Nest
HYCOM/MOM6 Ocean
WWIII Wave

# HAFS Release Activities in FY24

| Task # | Activity | Time |
|:---:|:---|:---:|
| 1 | **Multi-platform support (Cloud, RDHPCS, and External HPCS)** | Ongoing |
| 2 | **Scientific documentation** | In preparation |
| 3 | **User's guide** | In preparation |
| 4 | **Tutorial and workshop** | TBD |
| 5 | **Code repository management** | Ongoing |
| 6 | **Special issue in Frontiers in Earth Science  (Submission QR code:**  **)** | January 18, '24 |
| 7 | **Help desk** | TBD |
| 8 | **Public Release** | TBD |

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