

# FV3GFS NESTING STRATEGY AND TIMELINE

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# DISCUSSION TOPICS

## Development Plans

- Pre-processing tools supporting multiple static nests and moving nests
- Telescopic nests in FV3
- Moving nest algorithm in FV3
  - Within one cube face
  - Crossing cubed sphere edges/corners
- FMS code to enable the crossing edge algorithm - challenges / timelines

# PRE-PROCESSING TOOLS FOR MULTIPLE STATIC NESTS

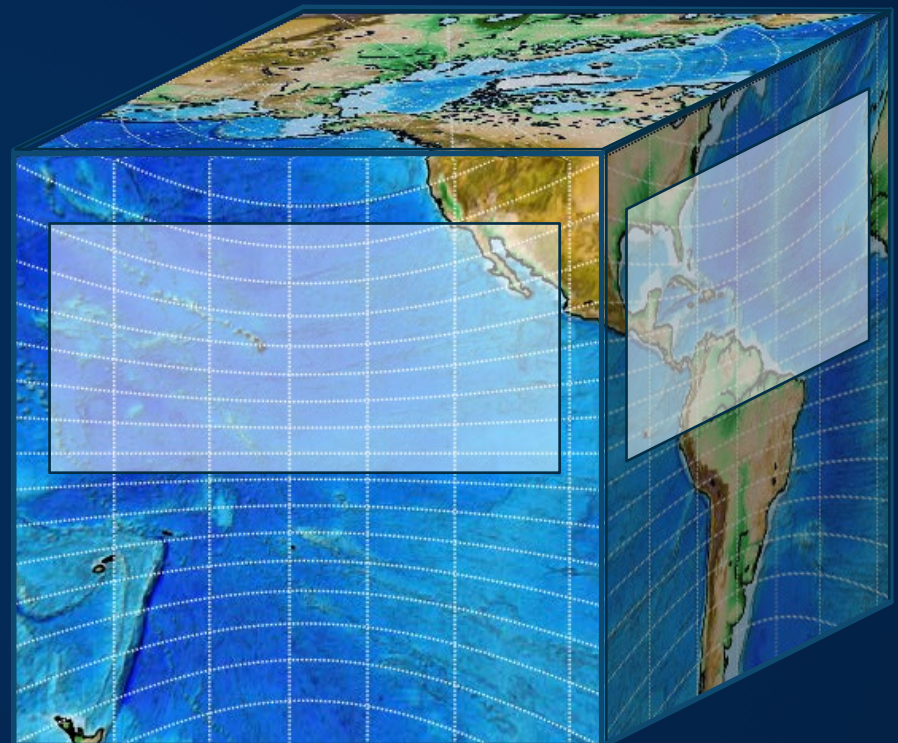
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## Extend from 1 to many nests

- Understand nesting code
- 1<sup>st</sup> stage toward multiple moving nests

## Summary of code modifications

- Grid and terrain generation step
  - C code
- Interpolation of GFS initial conditions (chgres)
  - Bash scripts



# PRE-PROCESSING TIMELINE AND MILESTONES



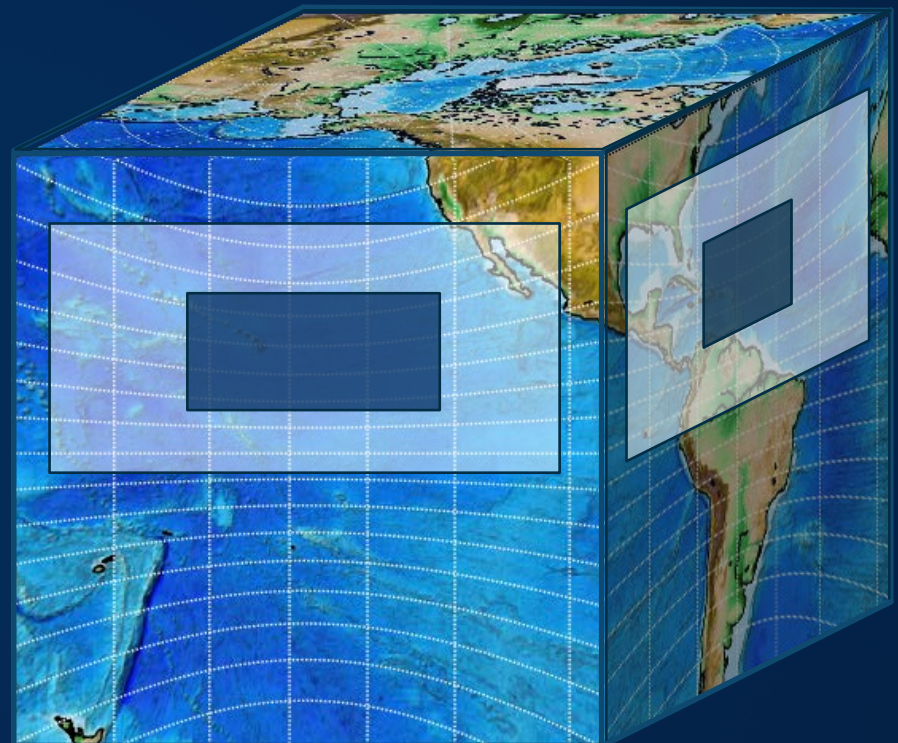
# TELESCOPIC NESTS

## Extend from single level nest to telescopic nests

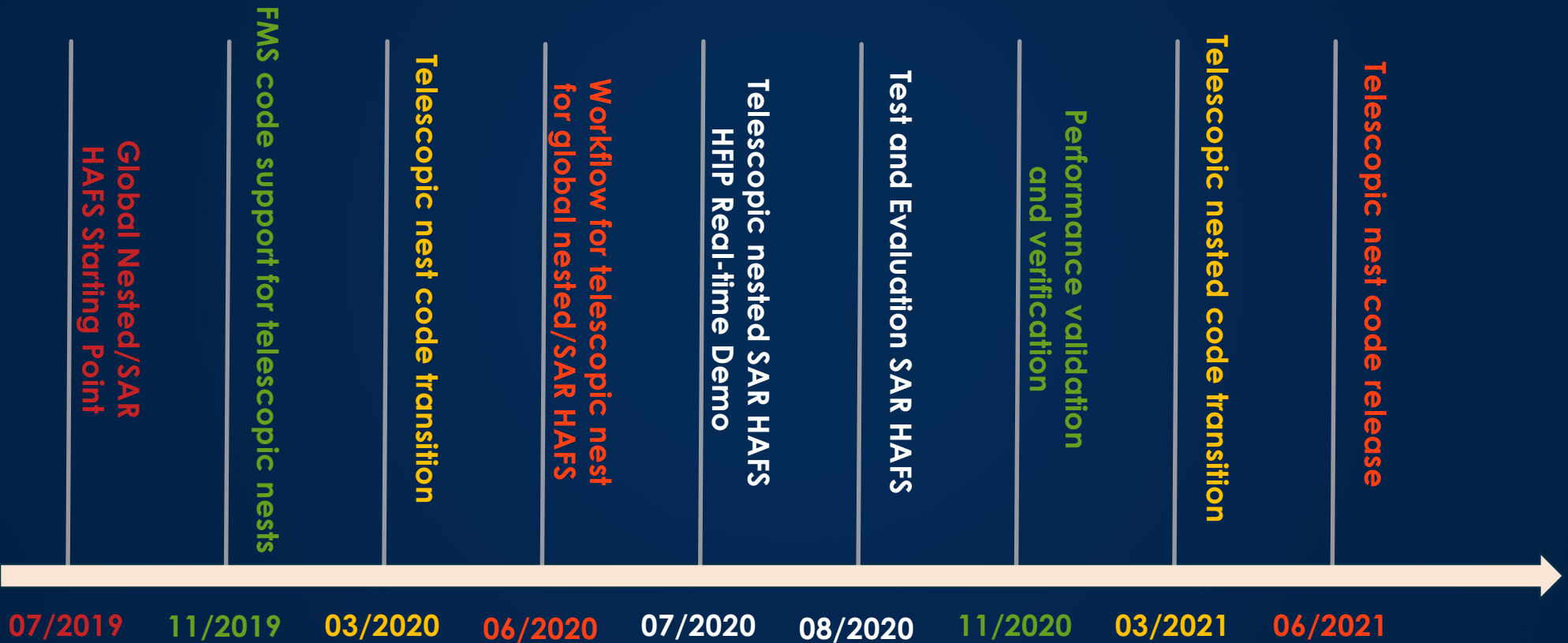
- 1<sup>st</sup> stage toward telescopic nests

## Summary of Code Modifications

- Grid and terrain generation step
  - C code
- Interpolation of GFS initial conditions (chgres)
  - Bash scripts
- FV3 dycore and physics drivers
- FMS



# TELESCOPIC NEST TIMELINE AND MILESTONES



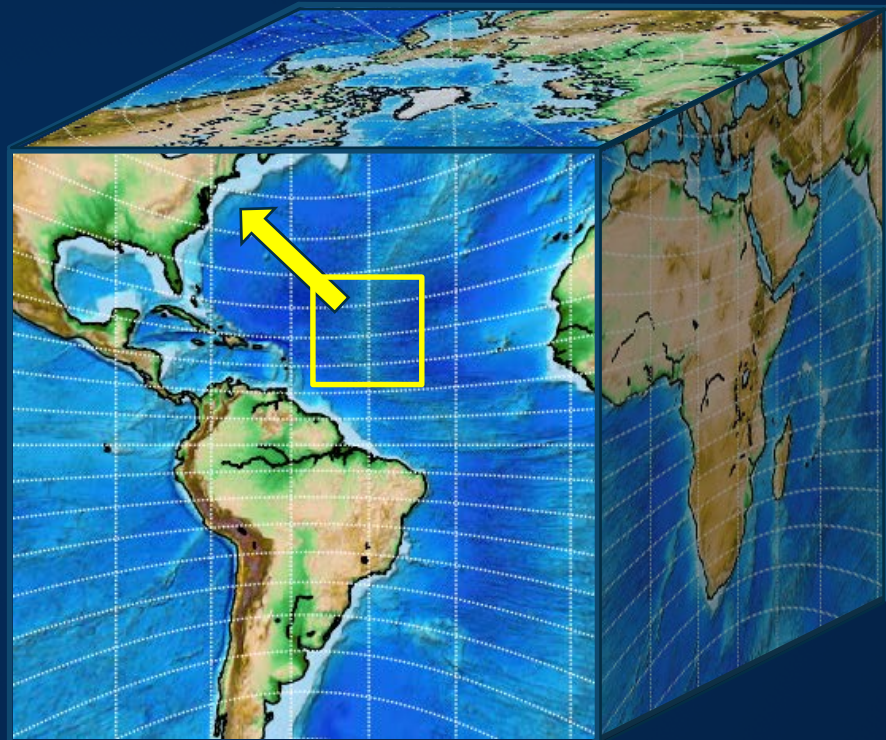
# MOVING NEST

## Initial Focus

- Transferring data between PEs
- Downscaling atmospheric data at leading edge from global tile

## Simplifications

- Movement in single cube face
  - Upgrade to edge/corner crossing
- Prescribed nest motion
  - Upgrade to storm tracking
- Nearest neighbor land/sea, surface fields
  - Upgrade to high res surface
- Single x or y grid point per timestep move
  - Upgrade to multiple grid point moves



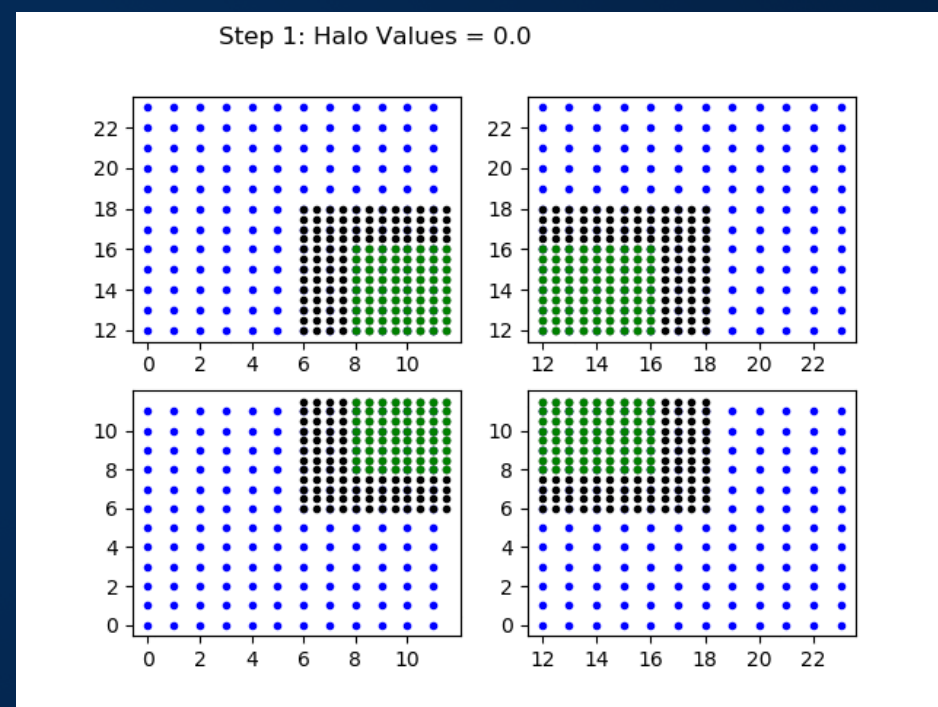
# MULTIPROCESSOR MOVING NEST PROTOTYPE

## Working Code

- Simplified nest motion running on 28 processors
- 5 timesteps of shifting nest westward 1 coarse grid cell at a time
- Test communication between processors
- 2D idealized field
- Great circle distance interpolation of data from coarse grid to fine grid

## Next Steps

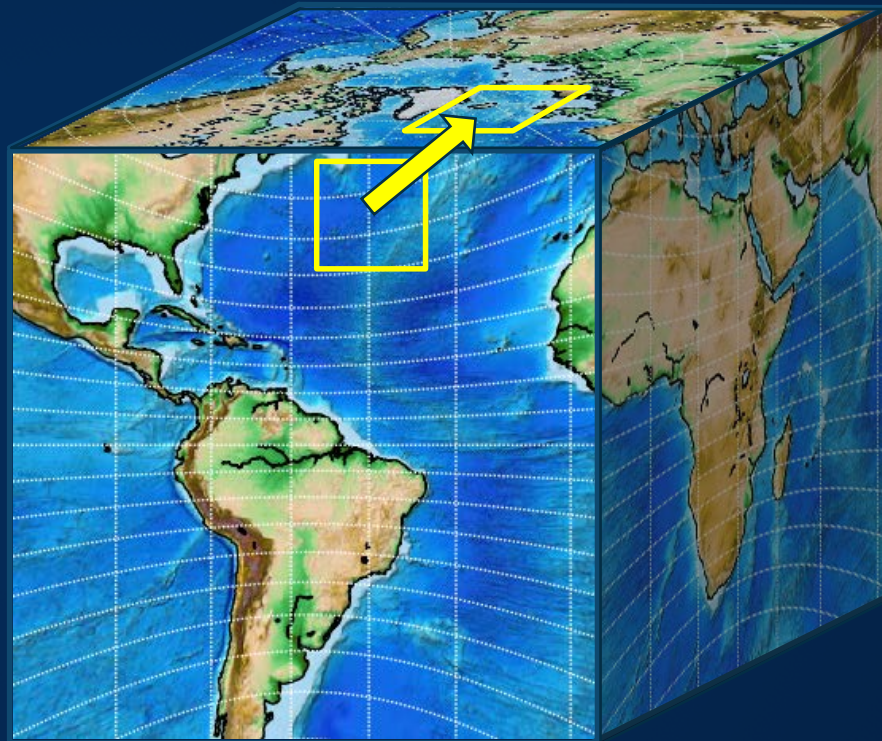
- Validation of accuracy of interpolation of 2D field
- Validation of feedback from fine nest back to coarse grid
- Extend to 3D fields and vectors (e.g. wind)





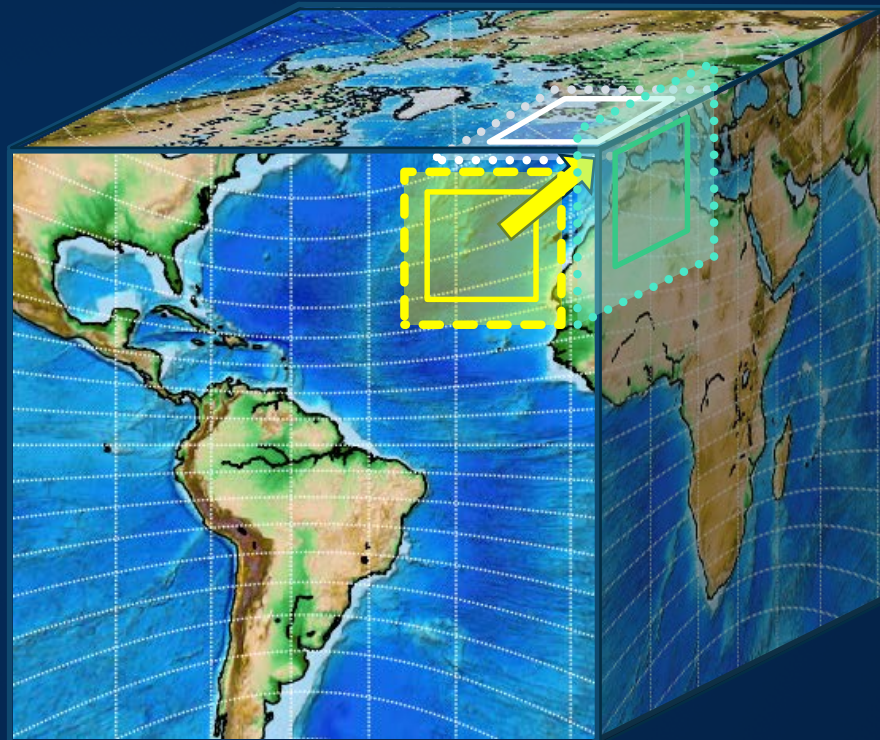
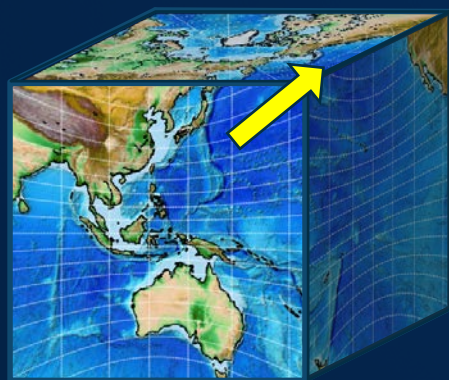
## NEST CROSSING CUBE EDGE

- Cube faces aligned to minimize TCs crossing edges
- Cannot entirely be avoided
- Reprojection necessary
- Handling of nest that straddles edge
- Unaligned lat/lon nest may be solution



# NEST CROSSING CUBE CORNER

- Corners in North Atlantic, North Pacific
- Leslie-type tracks might cross corner
- Halo crossing edges/corner

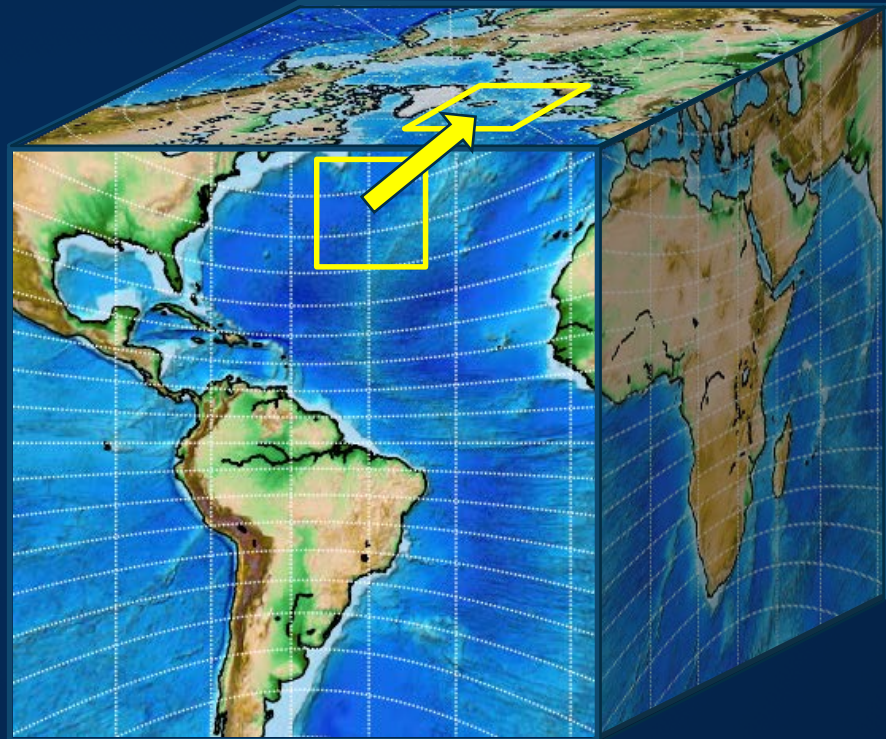


# MOVING NEST TIMELINE AND MILESTONES

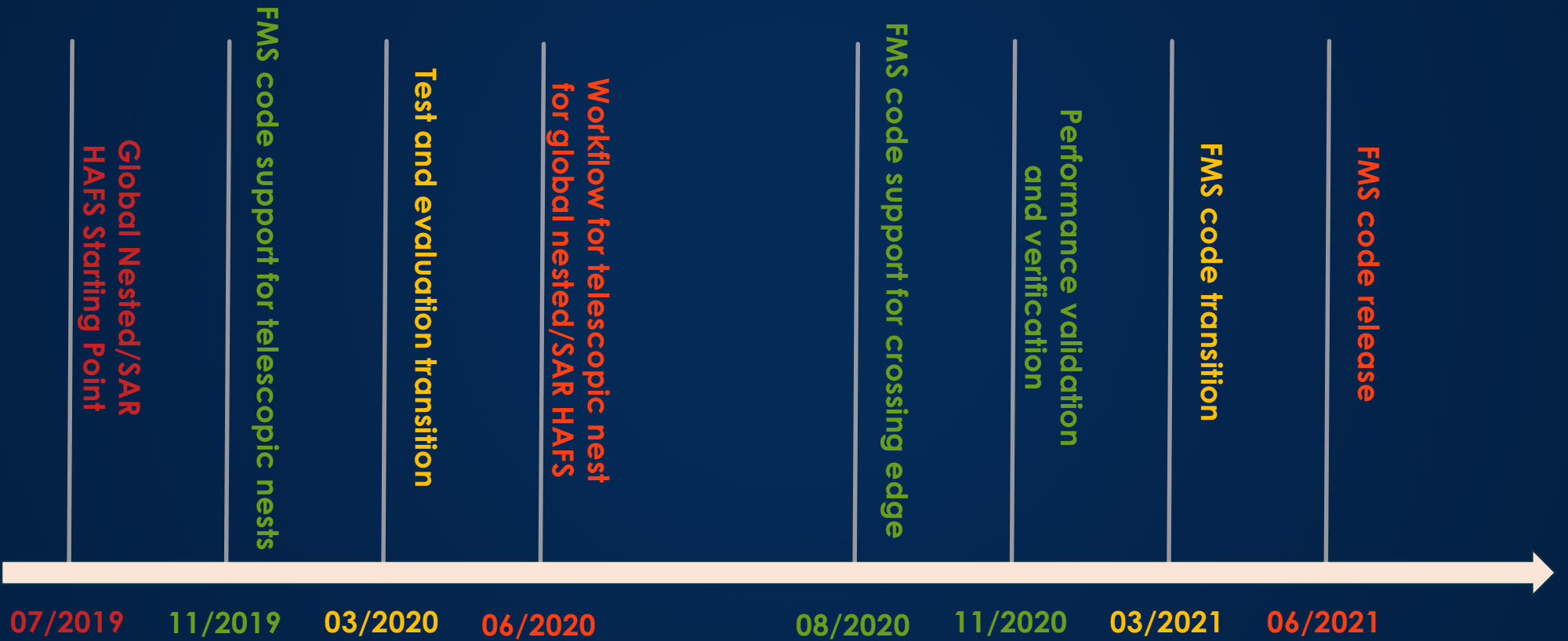


# FMS SUPPORT FOR CROSSING EDGE

- Existing FMS limited to one face  
one static nest
- Telescopic/multiple nests
- Moving nest in single face
- Moving nest cross edge



# FMS TIMELINE AND MILESTONES



# SUMMARY

- Single moving nest for hurricane season 2020 demo real time runs
- Multiple moving nests for hurricane season 2021 demo real time runs
- Telescopic nest for hurricane season 2020

EXTRA SLIDES

# MULTIPLE STATIC NEST CODE CHANGE SUMMARY

## Grid Generation

- `make_hgrid` now takes comma-separated lists of arguments to define nests
- C pointer arithmetic in `create_gnomonic_cubic_grid.c` required new arrays to index to multiple nests
- Shell script changes for nested grid and `oro_data` files

## Initial Conditions - `chgres`

- Bash script changes to allow multiple nests
- F90 code changes to permit all-ocean or all-land nests
  - Original code assumed global tiles and validated that interpolations occurred on each land mask type

## Dynamic Core

- `atmos_cubed_sphere`
  - `fv_control.F90` -- main modifications for multiple nests; indentation for readability
  - `fv_mp_mod.F90` -- permit more than 1 nest in loop
- `radiation_astronomy.f` -- added logging of elapsed time for forecast hours

## FMS

- `mpp_define_nest_domains.inc` -- validation of number of PEs



# OPEN QUESTIONS

## Tile Numbering

- Currently files are named like C96\_oro\_data.tile7.nc and C96\_oro\_data.tile10.nc
- Should we move to C96\_oro\_data.tile07.nc or C96\_oro\_data.tile007.nc?
  - + Default ordering in shell expansions would make more sense
  - Code changes throughout FV3 initialization and model, plus post processing

## Regression Procedures for Validating Forecast Reproducibility

- Suggestions on best practices?
- Optimal namelist settings to eliminate randomness
  - Are fixed seeds sufficient when number of nests/points changes?