BUILT FOR
TODAY.

DESIGNED FOR
TOMORROW.

Automating the GFDL Seasonal Prediction

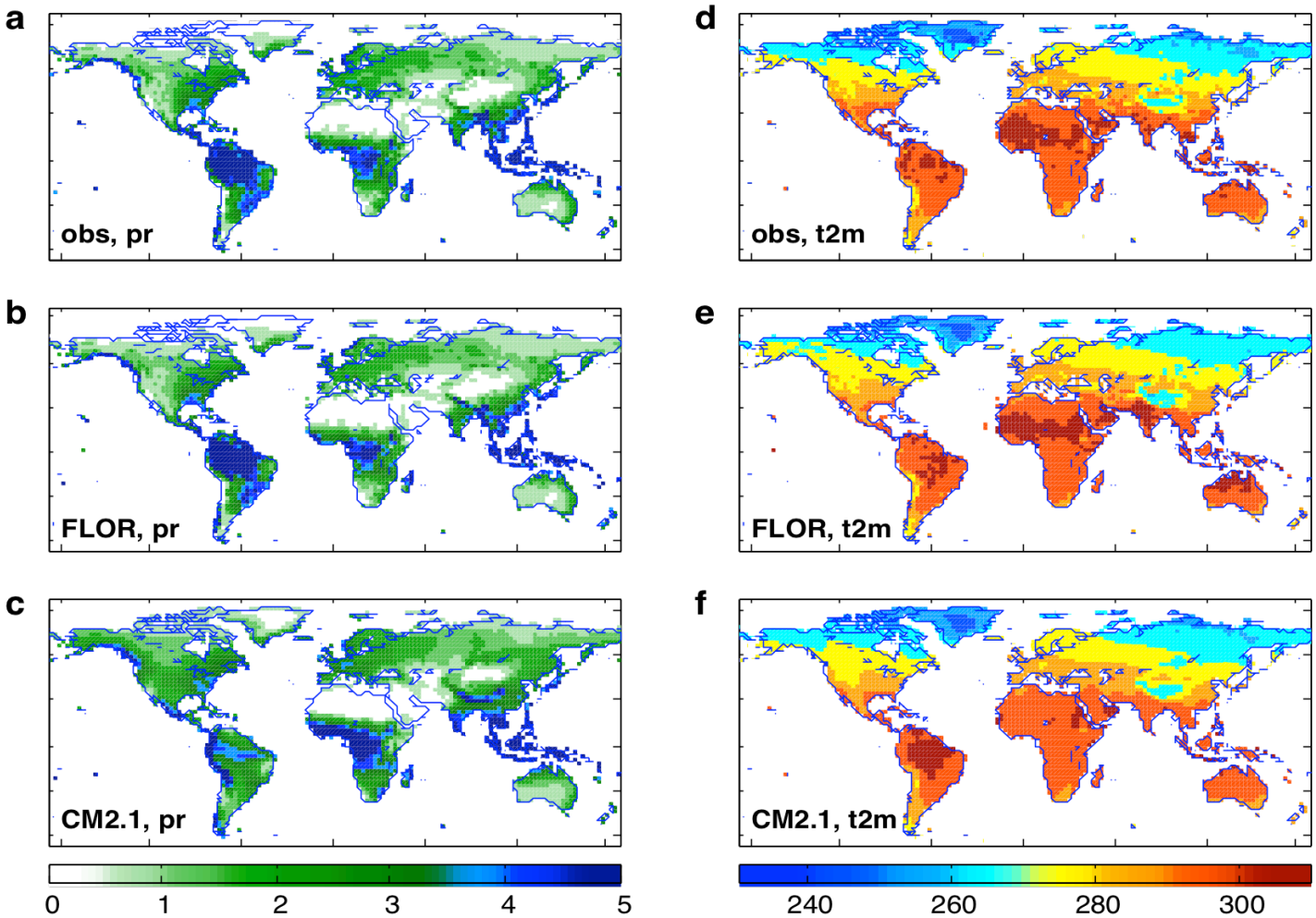
Seth Underwood
Engility (NOAA-GFDL)

ENGILITY
Your Mission. Our Commitment.

GFDL NMME Contribution

- GFDL Contributes 3 Models
  - GFDL CM2.1
    - 2ºx2.5º Atmos/land grid
    - 1ºx1º Ocean grid
  - GFDL FLOR (x2)
    - .5ºx.5º Atmos/land grid
    - 1ºx1º Ocean grid
- Plans to contribute HiFLOR
  - .25ºx.25º Atmos/land grid
  - 1ºx1º Ocean grid

GFDL NMME Contribution (Cont.)



Jia et al. (2014, J. Clim.)

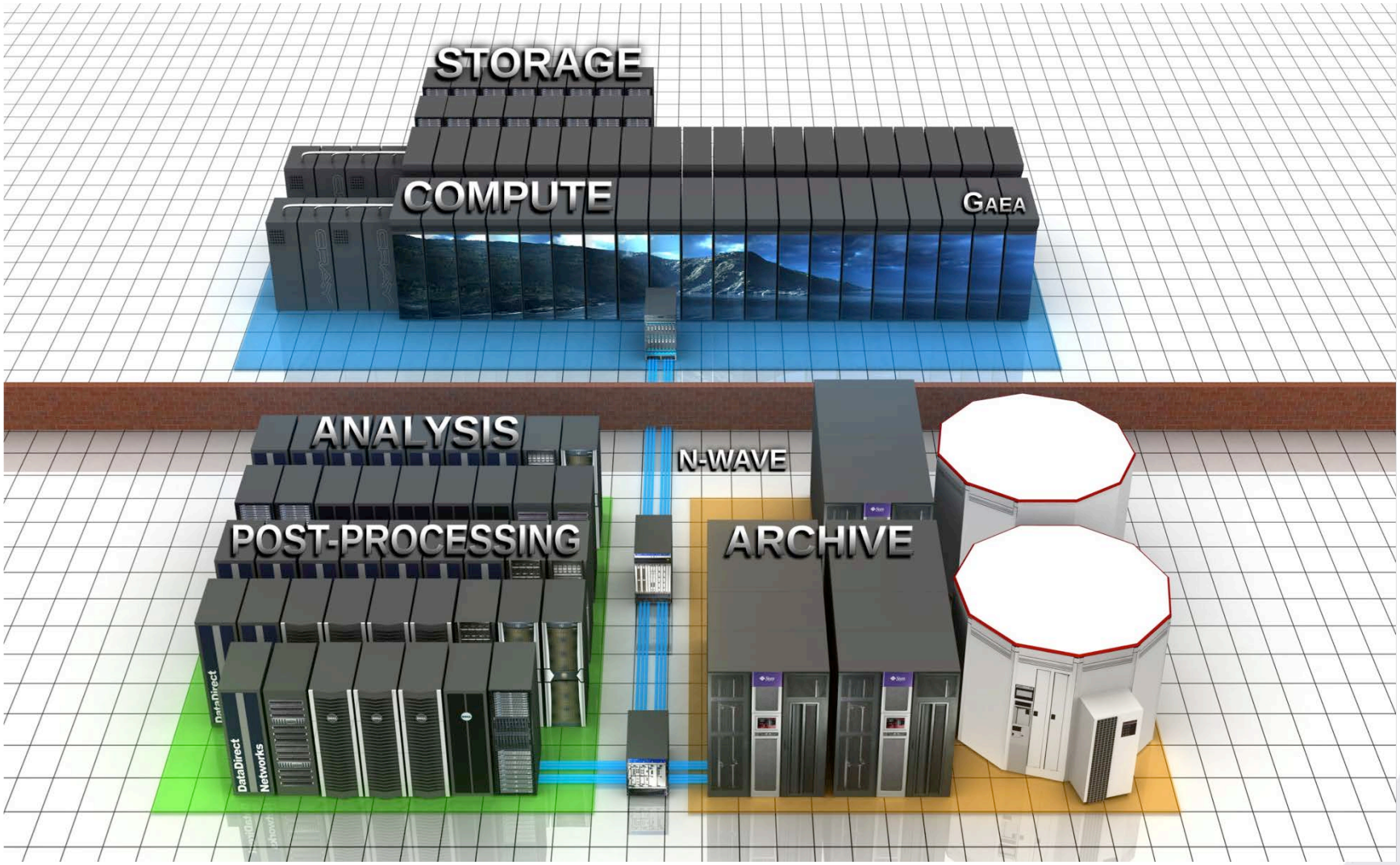
From Manual to Automated Process

- 4 Scientists dedicate 5-8 days to NMME prediction
- High probability of error
  - Using wrong initial conditions
- Each scientist developed their own process
  - Process only minimally documented (if documented at all)
  - No personnel backup

Automated Workflow

- Collection of scripts
  - POSIX shell (sh)
  - Using FRE and standard Linux commands
- Cron jobs
- FRE
  - Model Description XMLs
  - Production Runs
  - Post-processing/Analysis
- Multiple systems at multiple sites

GFDL Production / Post-Process System



Automation

- First steps: each scientist write out their process
  - Documentation created
- Second steps: translate process into scripts
- Third steps: develop “triggers” and “glue” scripts

Manual Process

- Gather four external observation datasets
- Process and QC external datasets
  - Prepare for ingestion into the GFDL model infrastructure
- Modify the FRE model description XML for the current month/year segment
- Run the CM2.1 ECDA model
  - Creates the initial conditions (IC) for CM2.1 and the ocean IC for FLOR

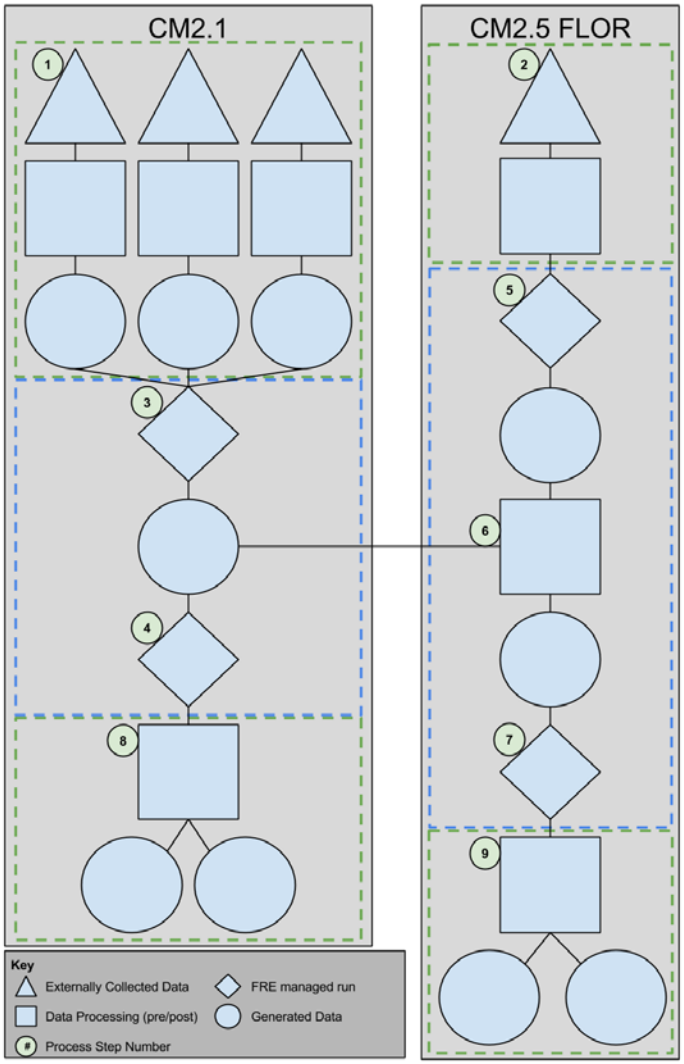
Manual Process (Cont.)

- Run the AMIP (Atmosphere only) model
  - Generates the atmosphere IC for FLOR
- Modify the CM2.1 model description XML for the current month/year
- Run the CM2.1 seasonal forecast model
  - FRE handles the model run and post-processing of the data
  - Manually process the post-processed data for the NMME submission

Manual Process (Cont.)

- Create IC for FLOR using files from the CM2.1 ECDA (Ocean/Ice) and the AMIP run (Atmos/land)
- Modify the FLOR model description XML
- Run the FLOR seasonal forecast
  - FRE handles the model run and post-processing of the data
  - Manually process the post-processed data for the NMME submission
- Create the NMME data files on a 1ºx1º grid from the post-processed data

Automated Workflow



Automation

- First steps: each scientist write out their process
  - Documentation created
- Second steps: translate process into scripts
- Third steps: develop “triggers” and “glue” scripts

Scripts

- Scientists previously developed their own
  - Each month required to edit to change the month/year
- Converted scripts to a POSIX shell and generalized
  - Use command line options to set month/year
- Use of config files to define directories
  - Scripts can easily be ported to a new system

FMS Runtime Environment (FRE)

- FRE is GFDL's workflow process
- Uses XMLs to define production run parameters
  - Generates production run script
  - Collects required input files
  - Transfers and post-processes model output
- FRE has been extended to handle multiple ensemble runs

Automation

- First steps: each scientist write out their process
  - Documentation created
- Second steps: translate process into scripts
- Third steps: develop “triggers” and “glue” scripts

Triggers and State

- Use *.OK files
  - Empty file
  - Presence indicates that any process that requires a certain file can proceed
- Each process creates a group of files
  - Existence of these files are used to determine if a process has begun
- “Glue” scripts run by CRON
  - Check for required files to know when to submit the next segment of the workflow
  - Use FRE to submit model runs on production system

Future Work

- Build a better fault tolerance process
- Ability to monitor process
- Investigate using cylc to manage workflow
  - Build on the FRE cylc work
  - Should give the ability to better monitor the process