Development of an Offline WRF/Chemistry model

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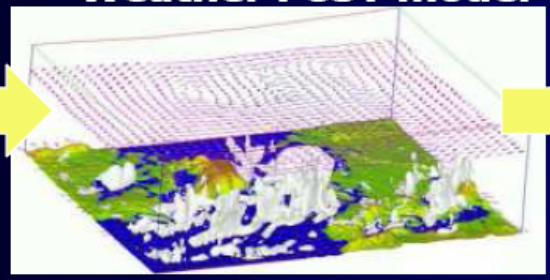
Structure

- Concept of an “Offline” Model
- Design of the Offline WRF/Chem
- Implementation Overview
- Online-Offline Comparisons
- Current Status

Offline Model - Concept

Weather Data Analysis & Assimilation

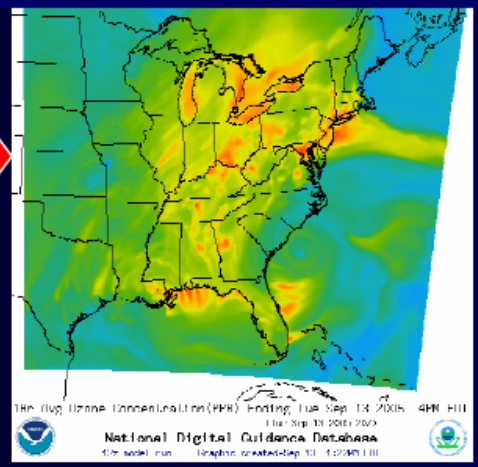
Weather FCST model



Weather-Forecast

Air quality FCST model

Biogenic and Anthropogenic emissions



AQ-Forecast

Removal modules

Need for an Offline Chemistry Model

When realtime meteorology and feedback not significant, and repeated chem runs . e.g.

- Model Development: introduction / improvement of chemical schemes
- Testing, Sensitivity studies
- Regulatory application (evaluation of emission control strategies)

Community request for comparison to other offline models

Comparison to online runs

Design of Offline WRF/Chem

- Seamless (Chem shouldn't know whether it is online or offline)
- Uniformity in Spatial resolution, schemes, parameterizations
- Use time averaged fields for interpolated meteorology to drive WRF/Chem CTM (mass consistent)
- Fully integrated in WRF Software Framework
- User-friendly, mainly runtime controls

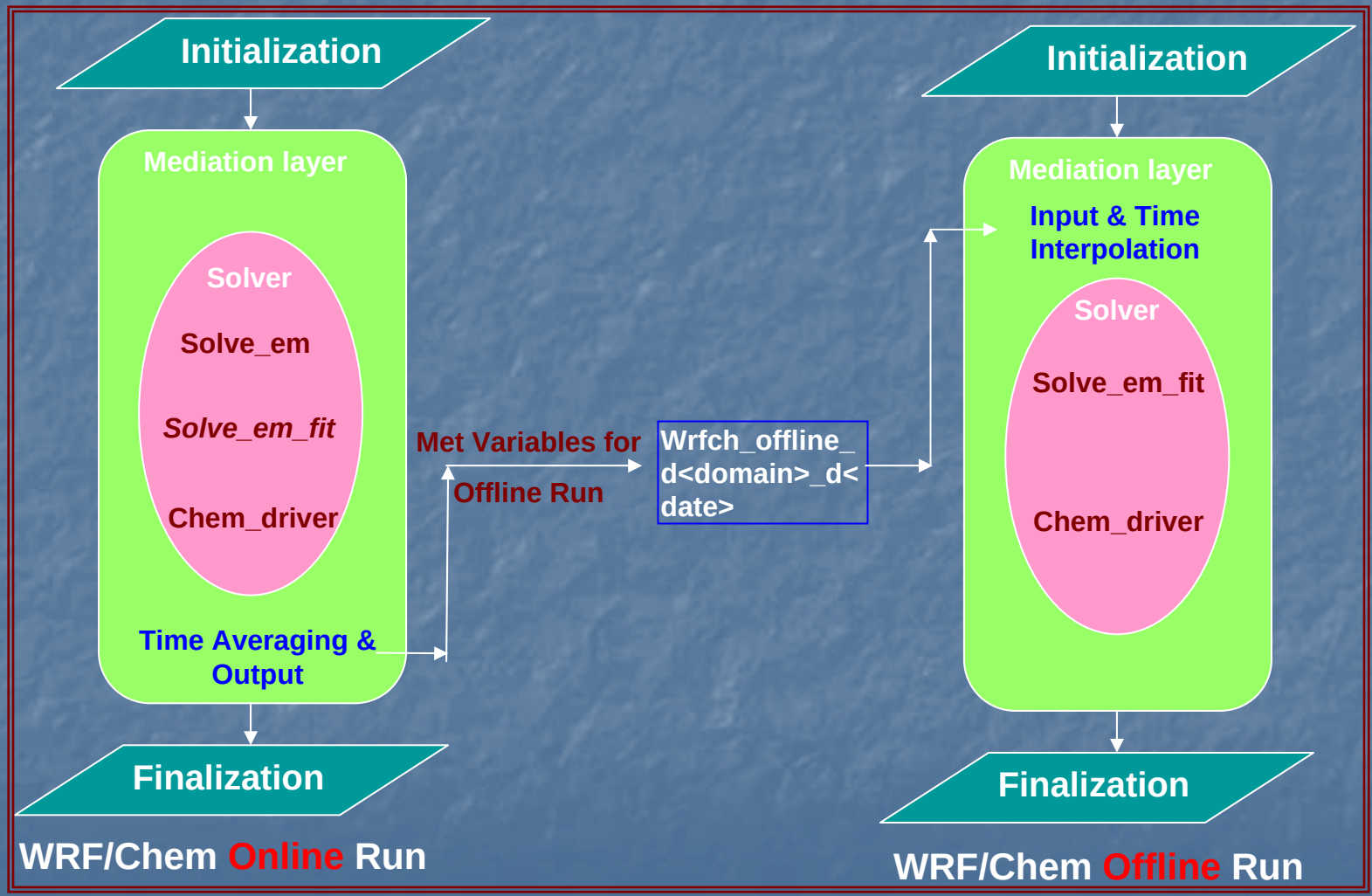
Implementation Overview

- Code & data flow analysis
  - Identify Met – Chem dependency & exchanges
  - Variables used by chem. and when to output (in given timestep)
- New advection scheme (FIT, W. Skamarock) for chemical species in offline (and online)
- Algorithm for Time averaging based on the timestep and desired frequency of output

Implementation Overview

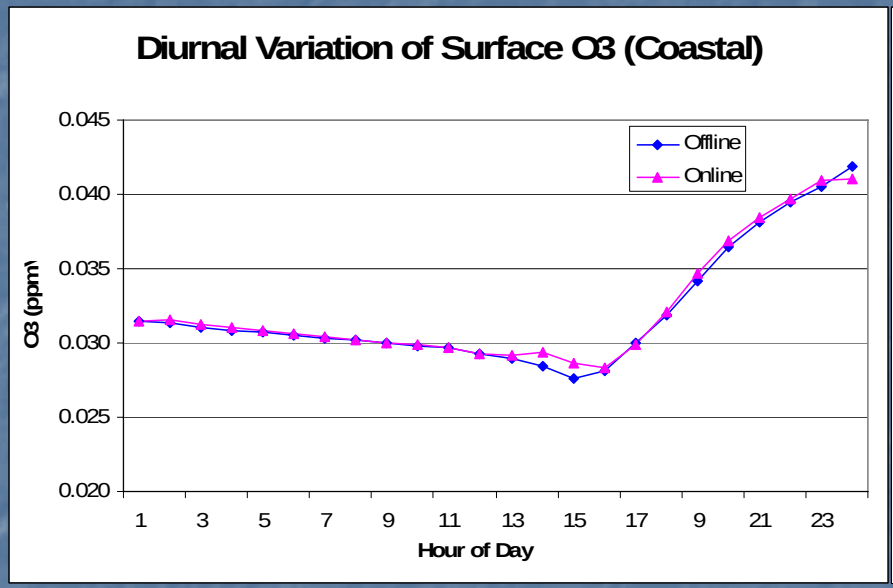
- Routines for averaging and output (Online); input and time interpolation (Offline)
- Integration into WRF Framework:
  - which operation goes into what layer
  - I/O using existing WRF streams and API
  - required variables defined in separate registry
  - compilation controlled by Environment variable
  - “Normal”, “Online” and “Offline” controlled by namelist variable
- Pre processing: output & input timestamp matching

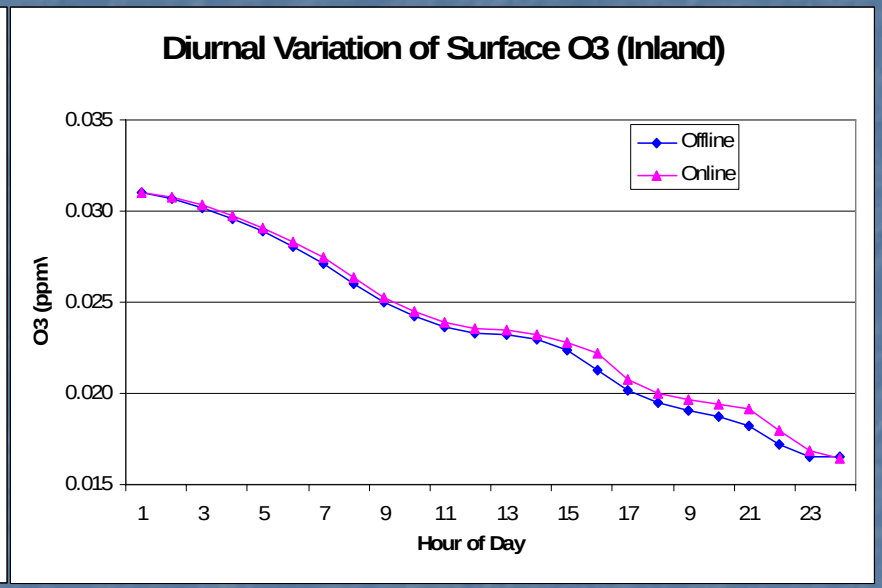
Flow Diagram for Offline Runs



Online - Offline Comparisons

60 km North-east US domain, hourly averaged

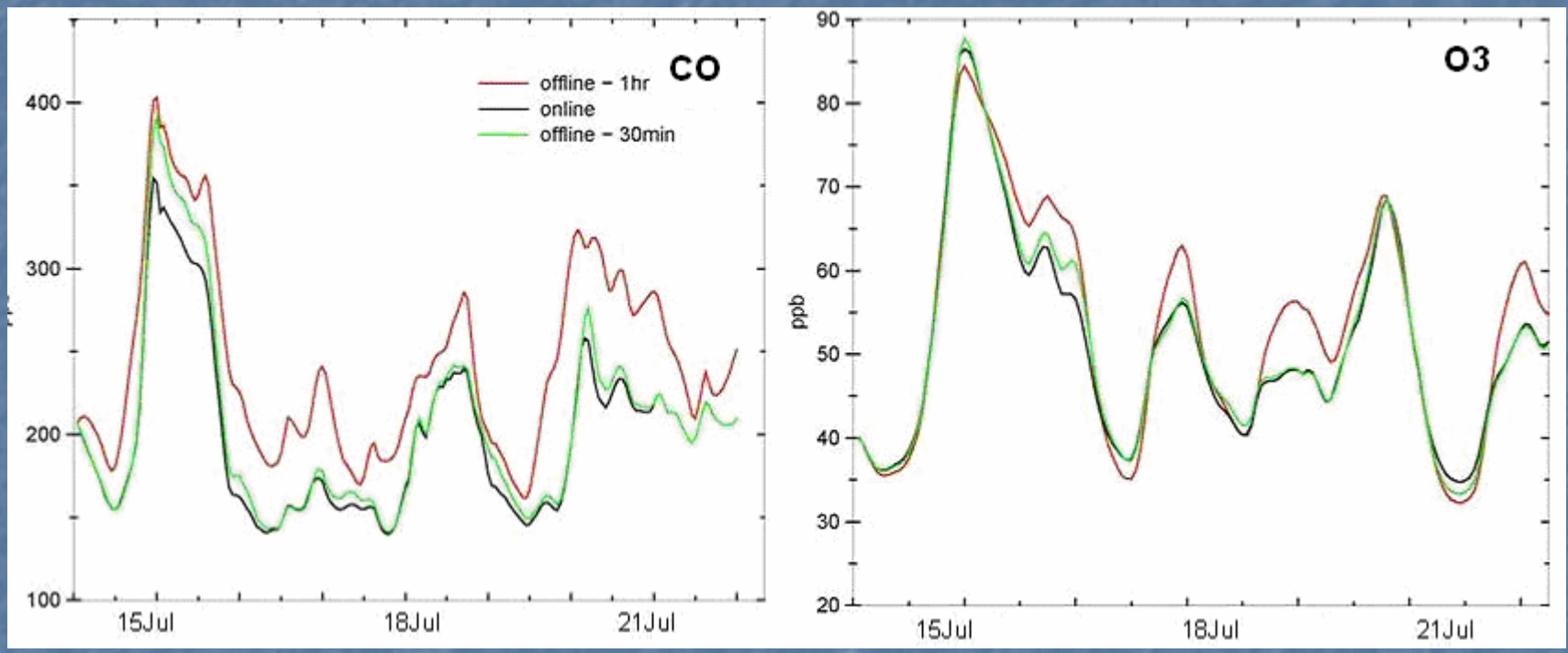




System	Online	Offline	Single offline run	10 online runs	10 offline runs	Gain
Xeon,Linux (4 cpu)	1200 s	1020 s	2220 s	12000 s	11400 s	15 %
IBM,AIX (4 cpu)	1856 s	1440 s	2296 s	18560 s	16256 s	13 %

Online - Offline Comparisons

12 km, New England, multiple averaging periods



Accuracy varies with averaging time at high resolutions.
Need more sensitivity studies before use

Current Status and Future work

- Implemented in WRF/Chem 2.2 – testing for repository inclusion
- Official release expected with WRF 3.0
- Improvements to FIT advection scheme (W. Skamarock)
- Online-offline sensitivity runs for different resolutions, chemical schemes
- Documentation and User guide

Thank You

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