LADCO | LAKE MICHIGAN AIR DIRECTORS CONSORTIUM

Exceptional Event Analysis and WRF Modeling for Regulatory Applications in the Midwest

Tsengel Nergui, Ph.D.

Atmospheric Modeler, Lake Michigan Air Directors Consortium

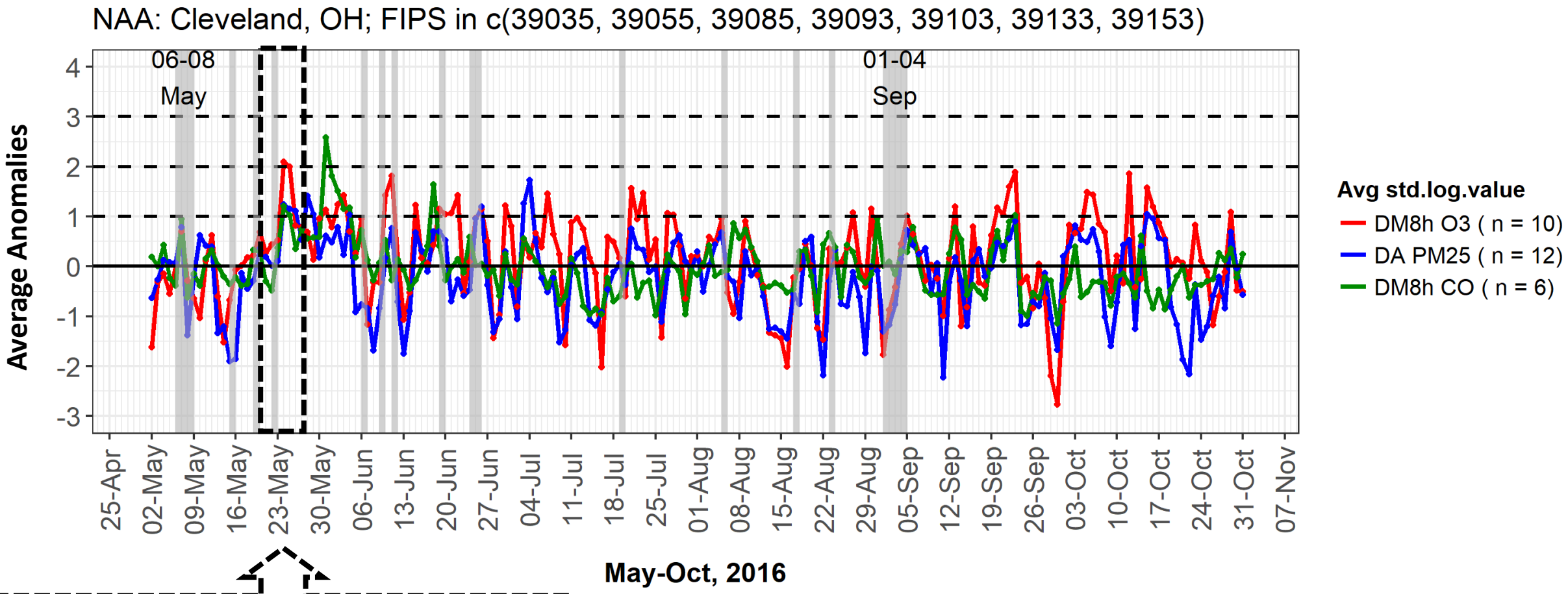
HAQAST Meeting, July 9-12, 2019, Pasadena, CA

LADCO's Role on EE Demonstration

- EE WG: Monthly Call since July 2018
- Initial Notification Process: help narrowing the number of sites/days for EEs
- LADCO created diagnostics based on AirNow Tech data to distinguish non-event and potential EEs
  - —HMS smk layer (manual inspection…!?)
  - —Providing time series plots for O3, PM2.5 and CO for each state, NAA and interested areas
    - —Standardized anomaly and residual (x-(μ +1σ)) time series for each site
    - —Average anomaly time series for each AQ variables for an area of interest
  - —Removed year to monthly variability from time series based on 2013-2017 records

(CO, $PM_{2.5}$, O_3 > 1σ) + (presence of smoke in the column) indicate potential EEs

Fort McMurray Fire EE Example



When the Screening Model Works (May 23-24)

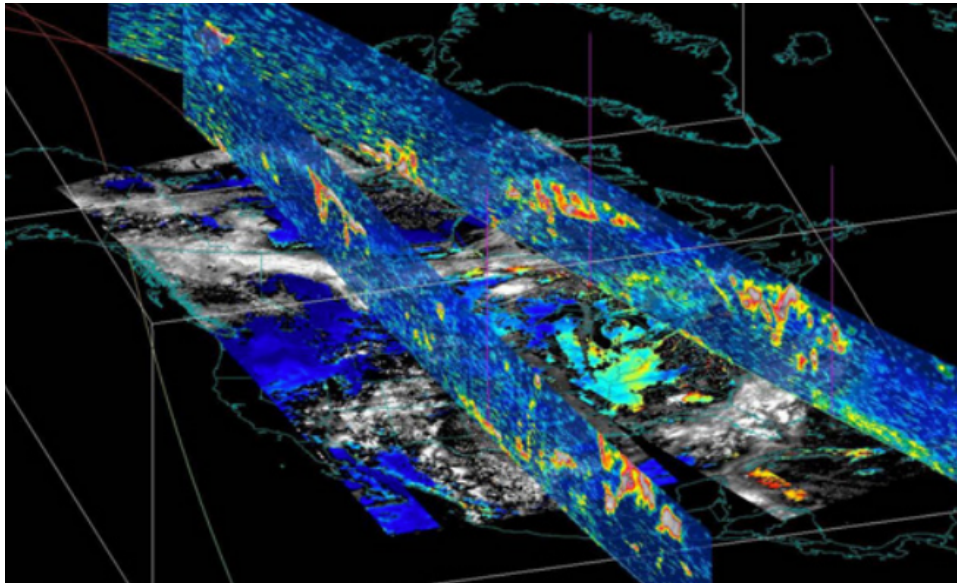
1. HMS smoke in the region on May 22
2. O_3 > 2σ & CO and $PM_{2.5}$ > 1σ
3. High pressure system on May 23-24

Source: AQS + HMS smk, AirNowTech.org

Discussion Points:

1. **Bring satellite data to site location**
   - Potential data sources
     - CALIPSO AOD
     - ISS CATS AOD Type Profile (aloft vs. sfc smk)
     - Hourly to daily cloud and smoke cover
     - …
   - Readily and easily accessible data in csv format
   - Temporal and spatial collocation (algorithms/scripts/footprint coverage)
2. **Knowledge on indicators and impacts of aged smokes on O3 and PM2.5**

Wish list: Consecutive cross section of AOD type profiles from CALIPSO/CATS over HMS smk layer



https://www.ssec.wisc.edu/mcidas/software/v/docs/SPIE%20Article%20on%20McIDAS-V_2008_07.pdf (Fig2, IDV)

2016 WRF Simulation for Regional Haze Planning

Finding the best performing Config:

— Physics options (PBL, LSM, mp, SL)

— Initialization data

— Nudging configuration

— SST over the Great Lakes

CASE1 = LADCO2016_WRFv39_**YNT_GFS_gs**da (d01-d03)

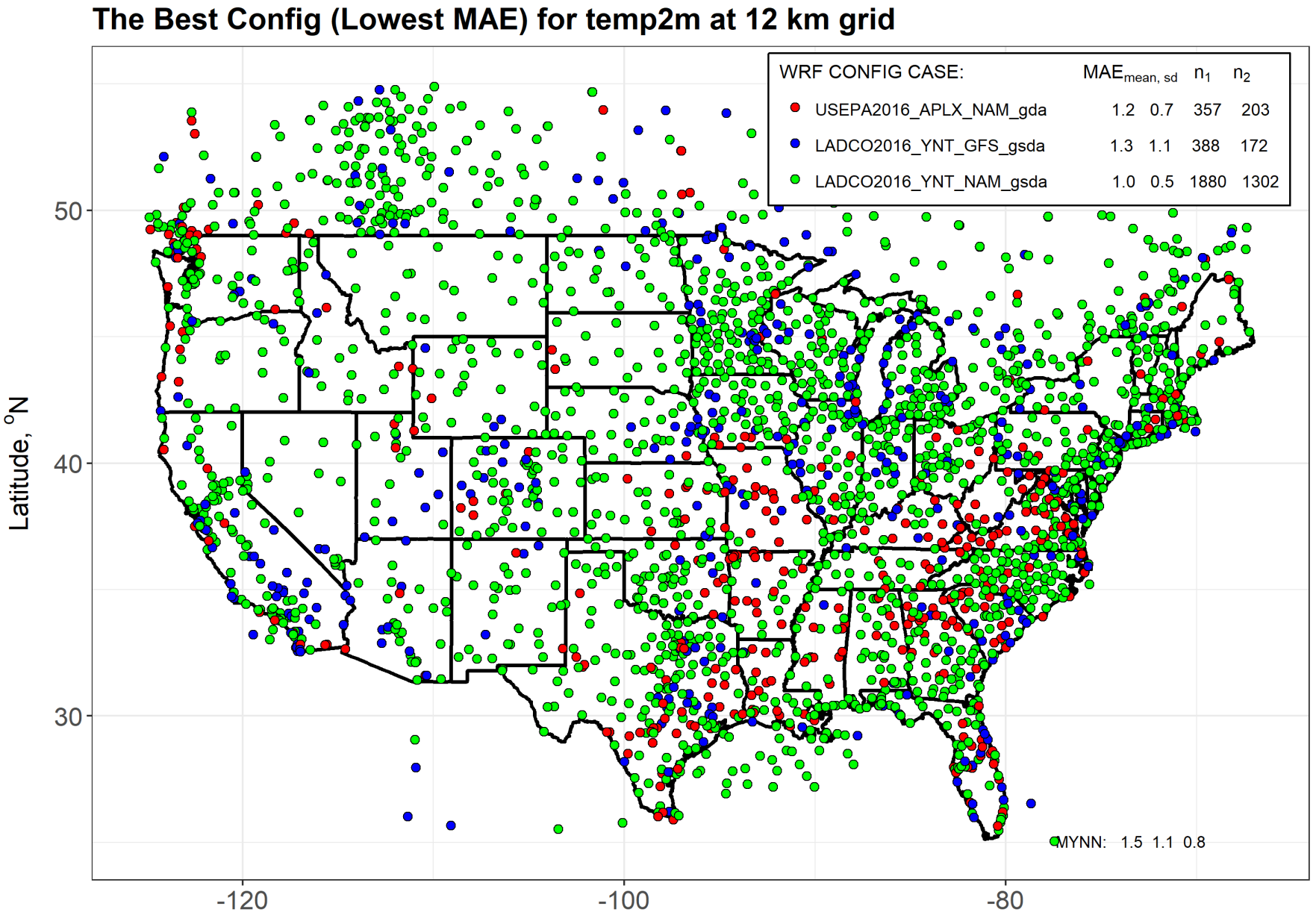
- **Y**SU PBL, Unified **N**oah LSM, **T**hompson's microphysics, MM5 Monin-Obukhov surface layer option
- **GFS** Grid4 **(~25km, 6hr fdda)**
- 3D **g**rid (d02 and d03) and **s**urface observation nudging (d02)
- **GLSEA SST** over the Great Lakes

CASE2 = LADCO2016_WRFv39_**YNT_NAM_gs**da (d01-d03)

- **Y**SU PBL , Unified **N**oah LSM, **T**hompson's microphysics, MM5 Monin-Obukhov surface layer option
- **NAM**218 **(12km, 3hr fdda)**
- 3D **g**rid (d02 and d03) and **s**urface observation nudging (d02)
- **GLSEA SST** over the Great Lakes

CASE3 = LADCO2016_WRFv39_**APLX_NAM_g**da_**nd** (d02, d03)

- **A**CM2 PBL, **Pl**eim-**X**iu LSM, Morrison 2 moments microphysics, Pleim-Xiu surface layer option
- NAM218 (12km, 3hr fdda)
- 3D **g**rid nudging
- ICBC from USEPA's 12km WRF output (**nd**own)
- **GHRSST** over the domain



For 12 km grid, YNT_NAM (3hr fdda) had better performance for T and WD.

Discussion Points:

1. Best WRF Configuration for LADCO region (Preliminary Results)

Met variable	12 km	4 km	1.33 km
Temp	YNT_NAM	YNT_GFS/NAM	YNT_GFS or APLX_NAM
Wind Dir	YNT_NAM	YNT_GFS/NAM	YNT_GFS or APLX_NAM

2. AMET Model Performance Statistics

- T, Q, WS, WD
- Other variables: readily available and easily assessable in useful format?
  - Hourly cloud cover (cu_option and mp_option)