Regional Modeling Center Sensitivity Modeling Analyses

Inter-RPO Modeling Discussion Group

June 9, 2005

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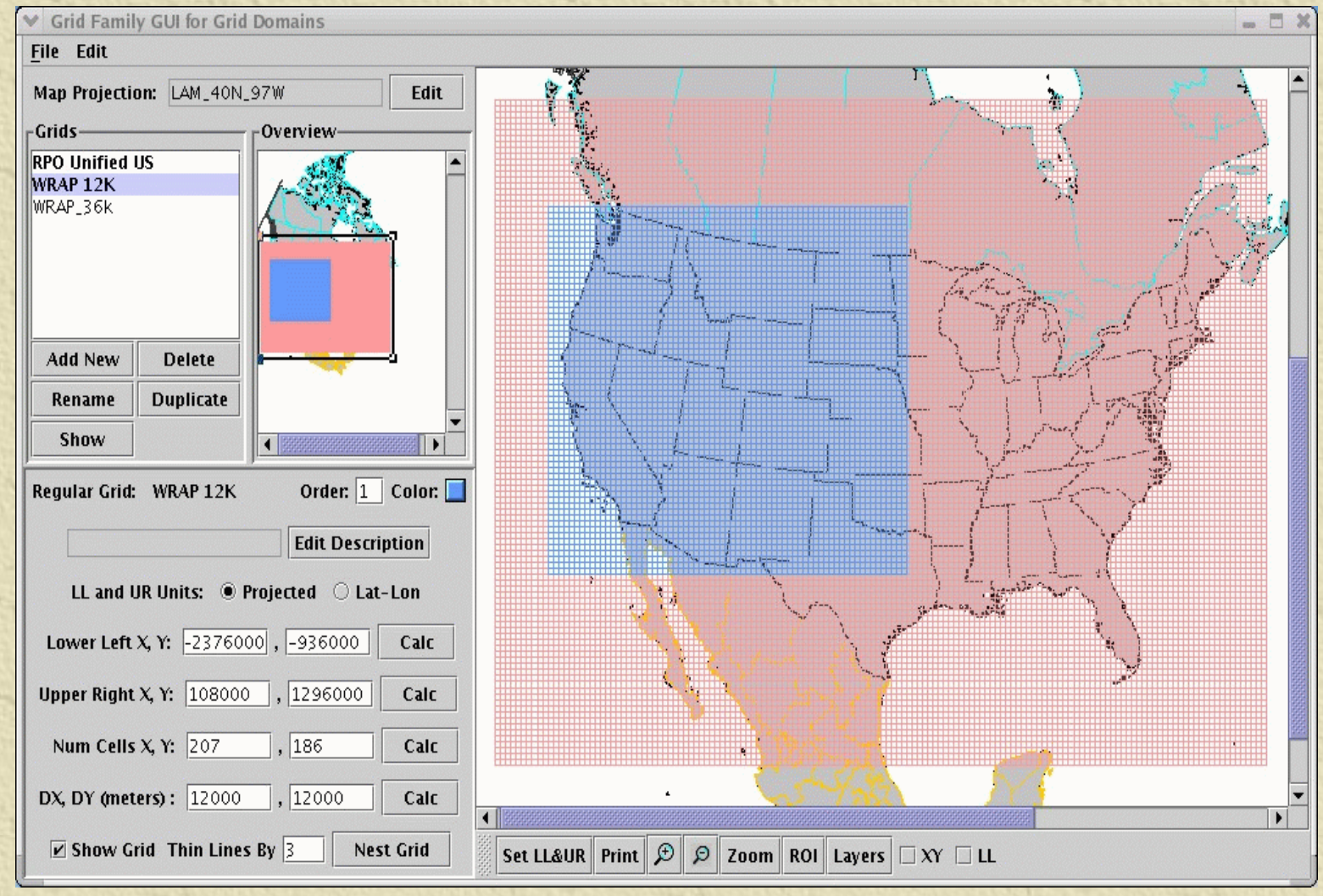
Work of Tonnesen, et. al.

WRAP RMC Sensitivity Modeling

- Natural Emissions
- Fire
- Windblown Dust
- Future work

WRAP Modeling Domains



Natural Emissions Sensitivity Modeling

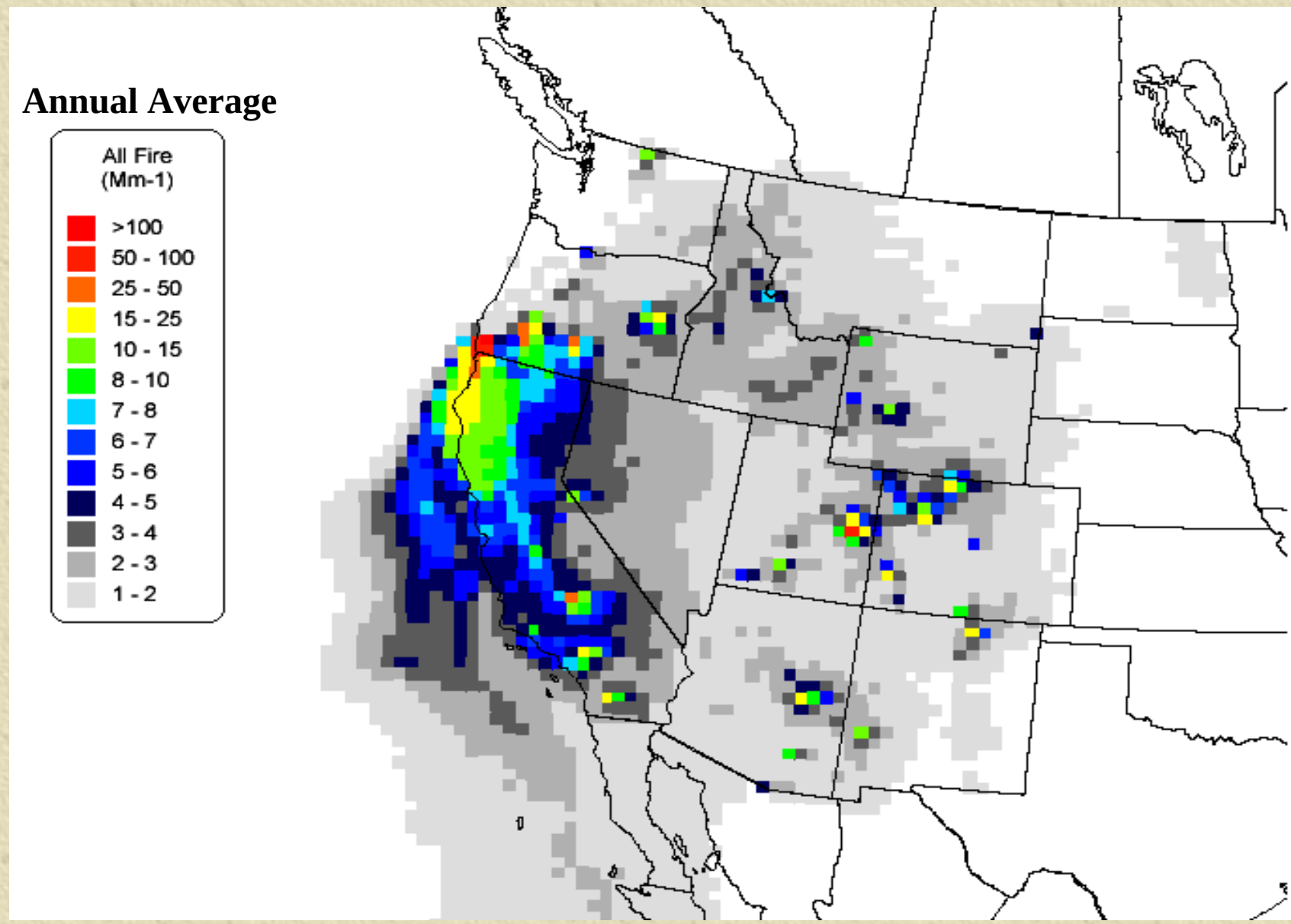
- **WRAP RMC ran sensitivity simulation for natural emissions during Summer 2002**
- **Emissions sources**
  - **Typical 30-year average wildfire**
  - **Biogenics**
  - **Ammonia**
  - **Clean Boundary Conditions**

Natural Emissions Modeling Results

- Highest ozone was 100 ppb, associated with fires
- Sulfate:
  - Dominated by boundary conditions
  - Decreased rapidly away from domain boundaries
- Extinction ~10 Mm^{-1} including Rayleigh for most areas, i.e., zero contribution from PM
- Maximum modeled reconstructed extinction:
  - Ranged up to ~40 Mm^{-1} in areas with large biogenic emissions and/or near fires
  - Boundary effects show up near boundaries, but do not appear to affect interior WRAP region

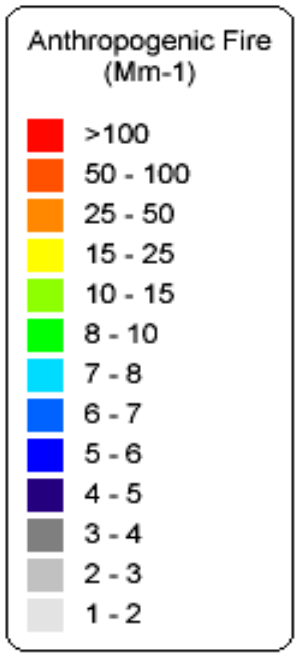
Visibility Impact of All 2002 Fire Emissions

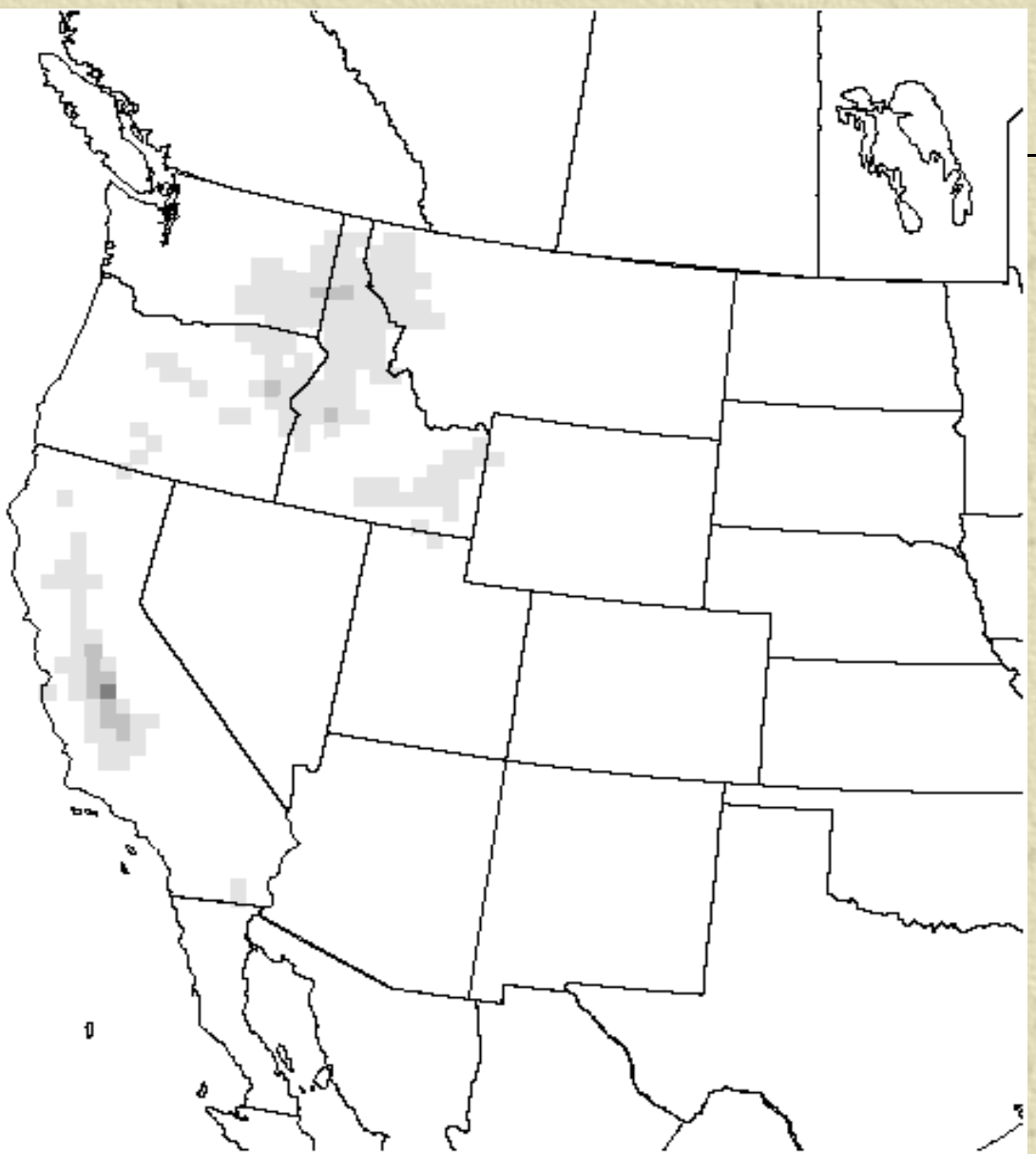
Annual Average



Visibility Impact of 2002 Anthropogenic Fire Emissions

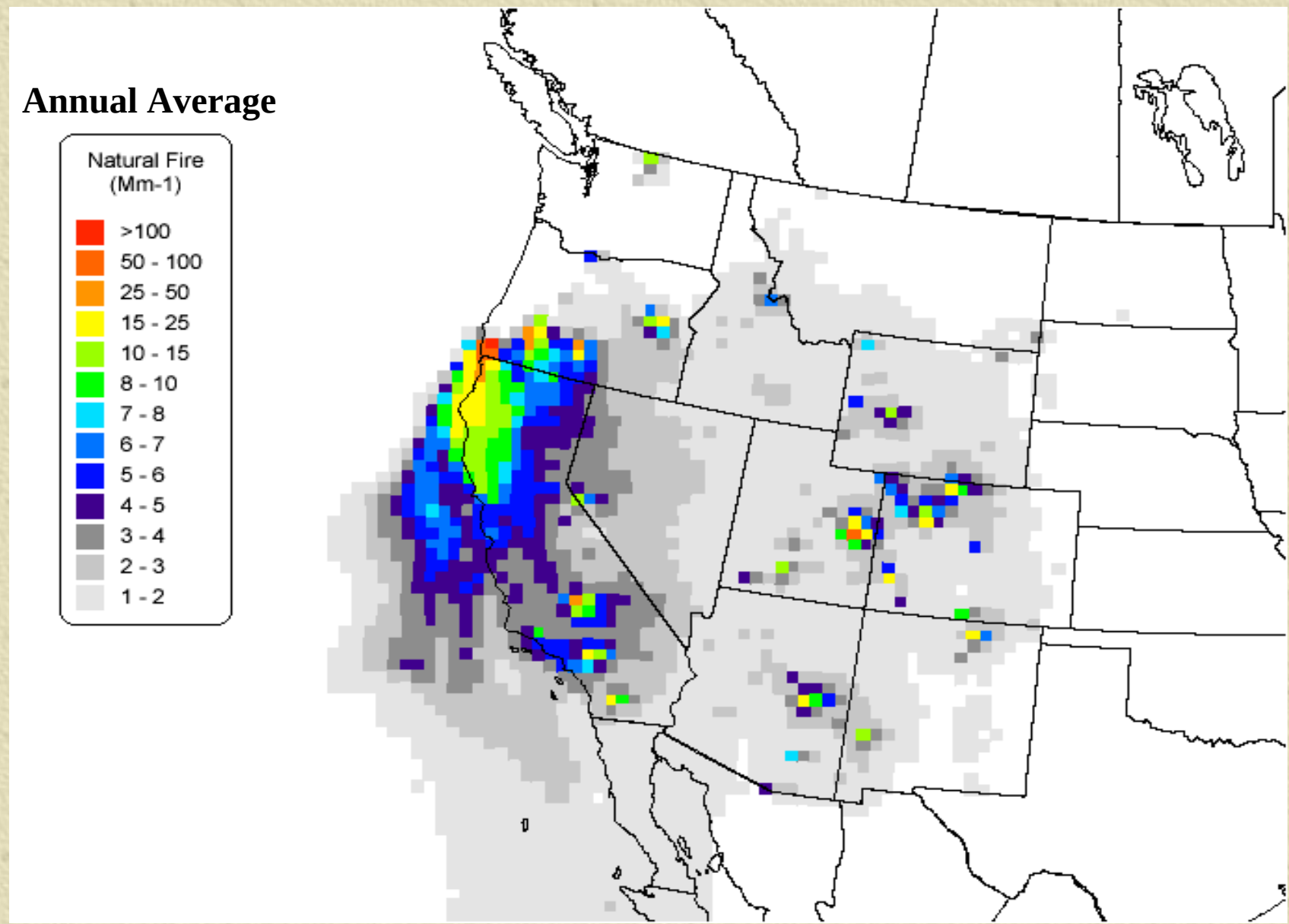
Annual Average



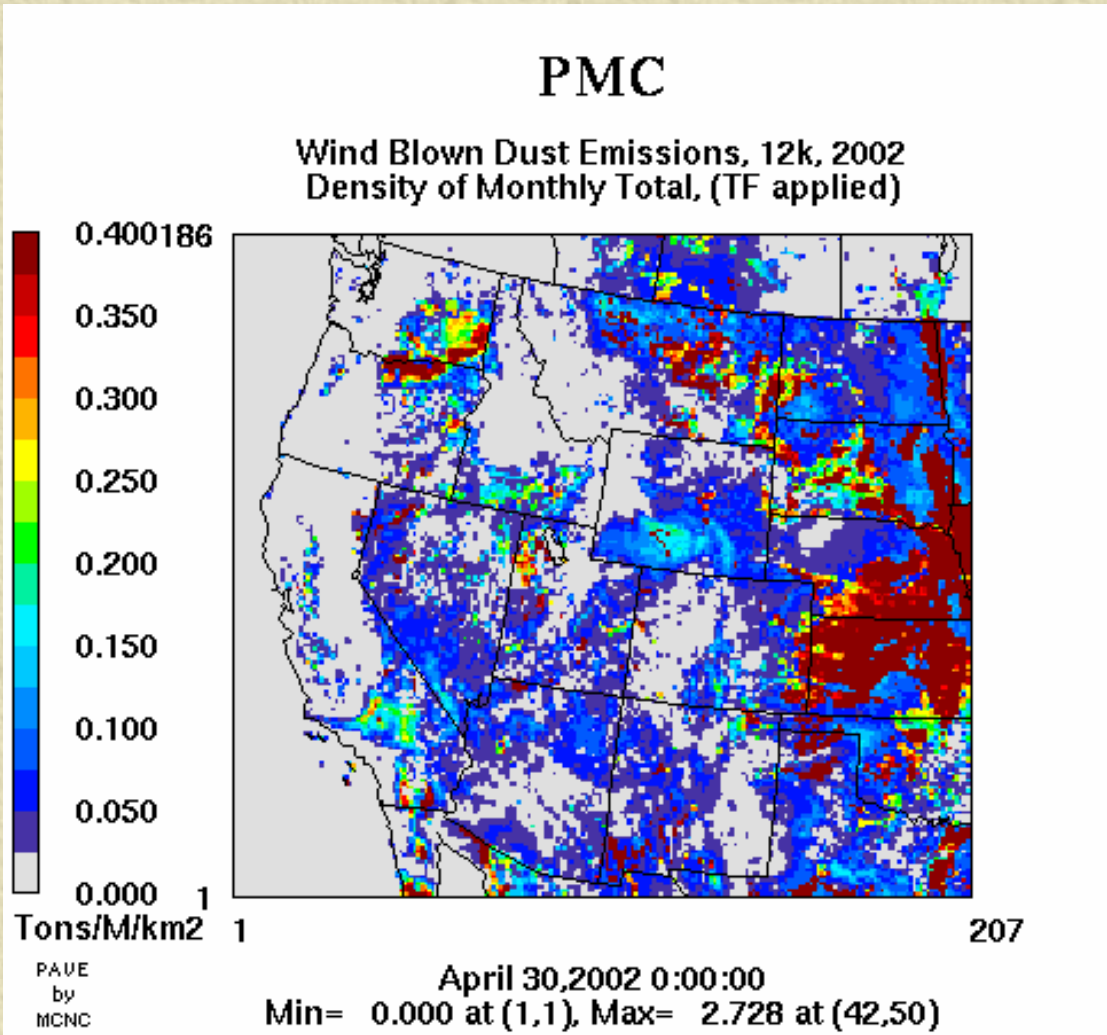


Visibility Impact of 2002 Natural Fire Emissions

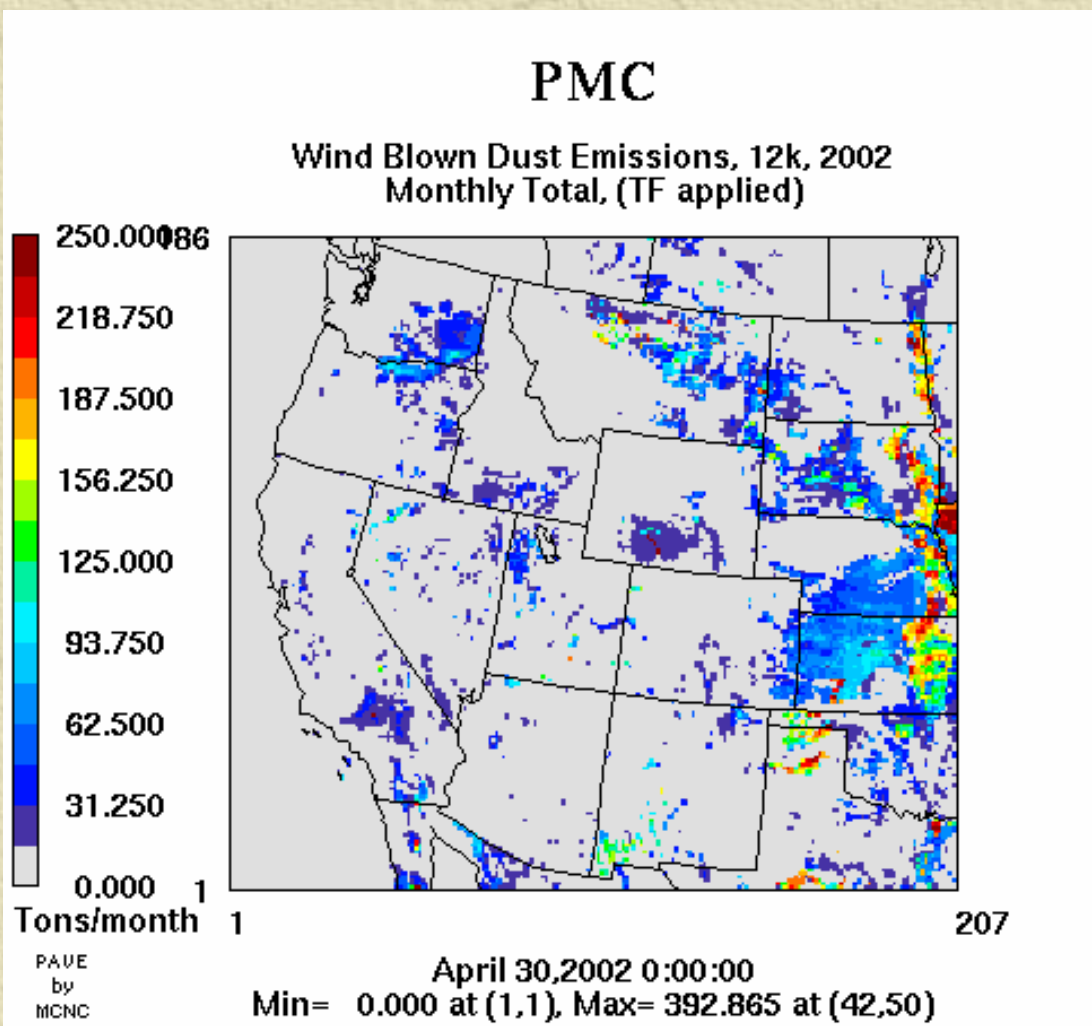
Annual Average



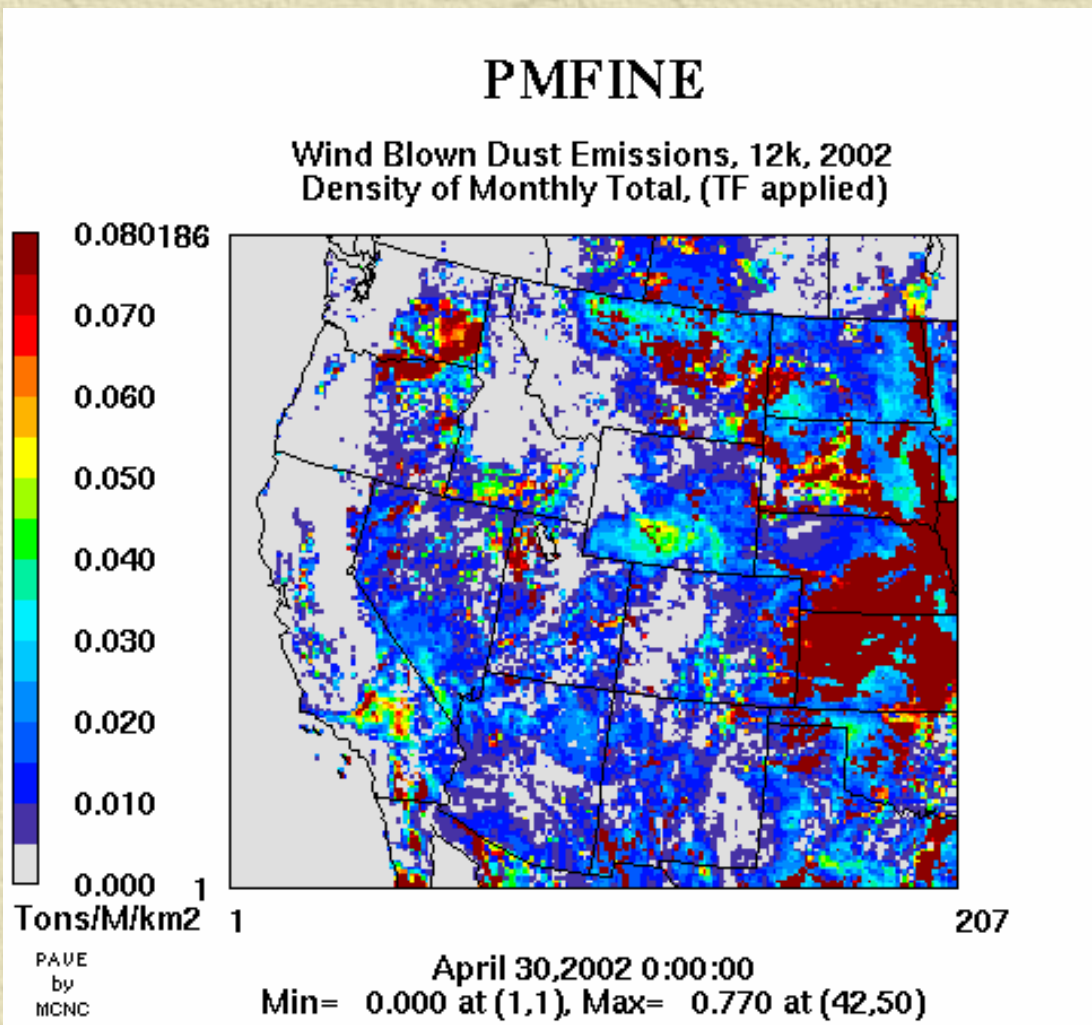
PM Coarse Windblown Dust Densities



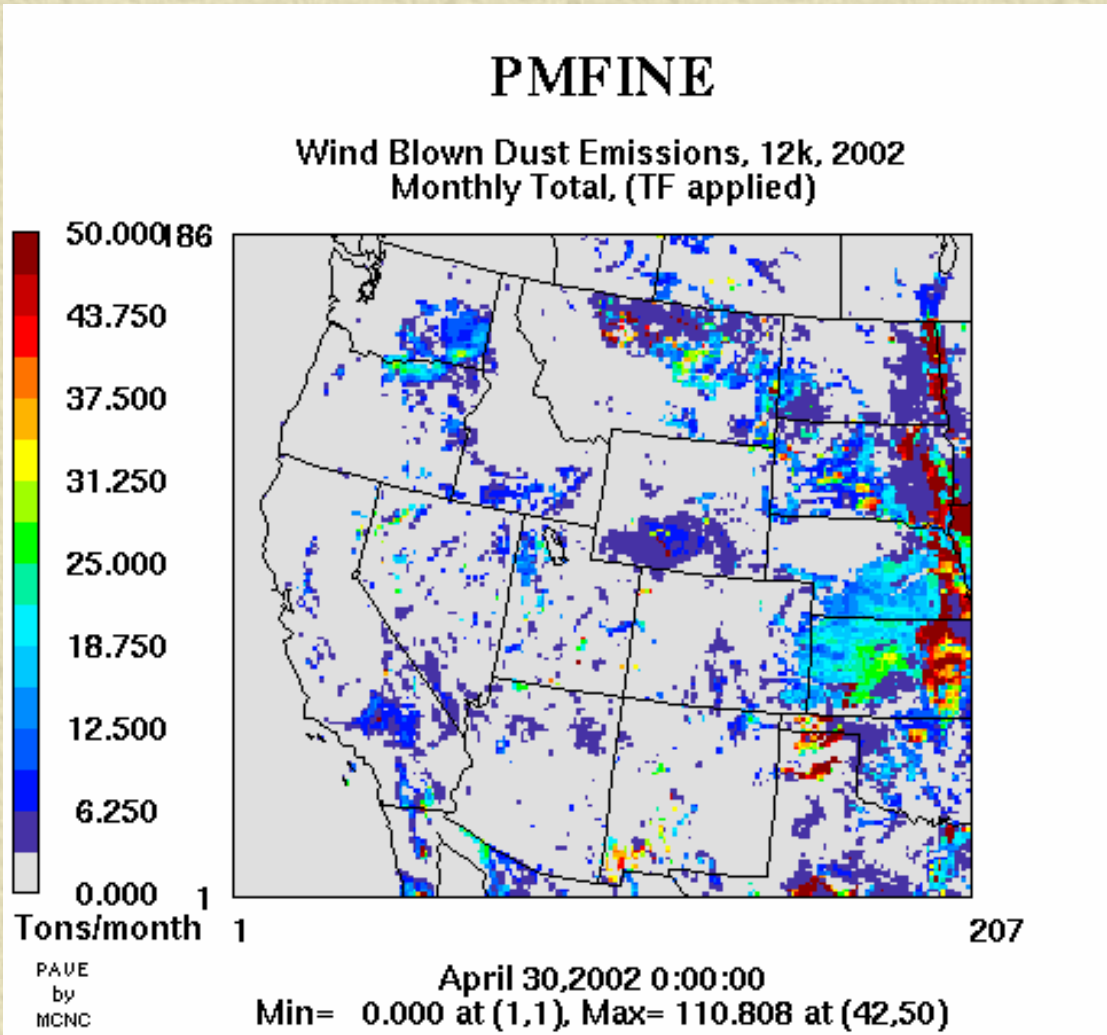
PM Coarse Windblown Dust Densities



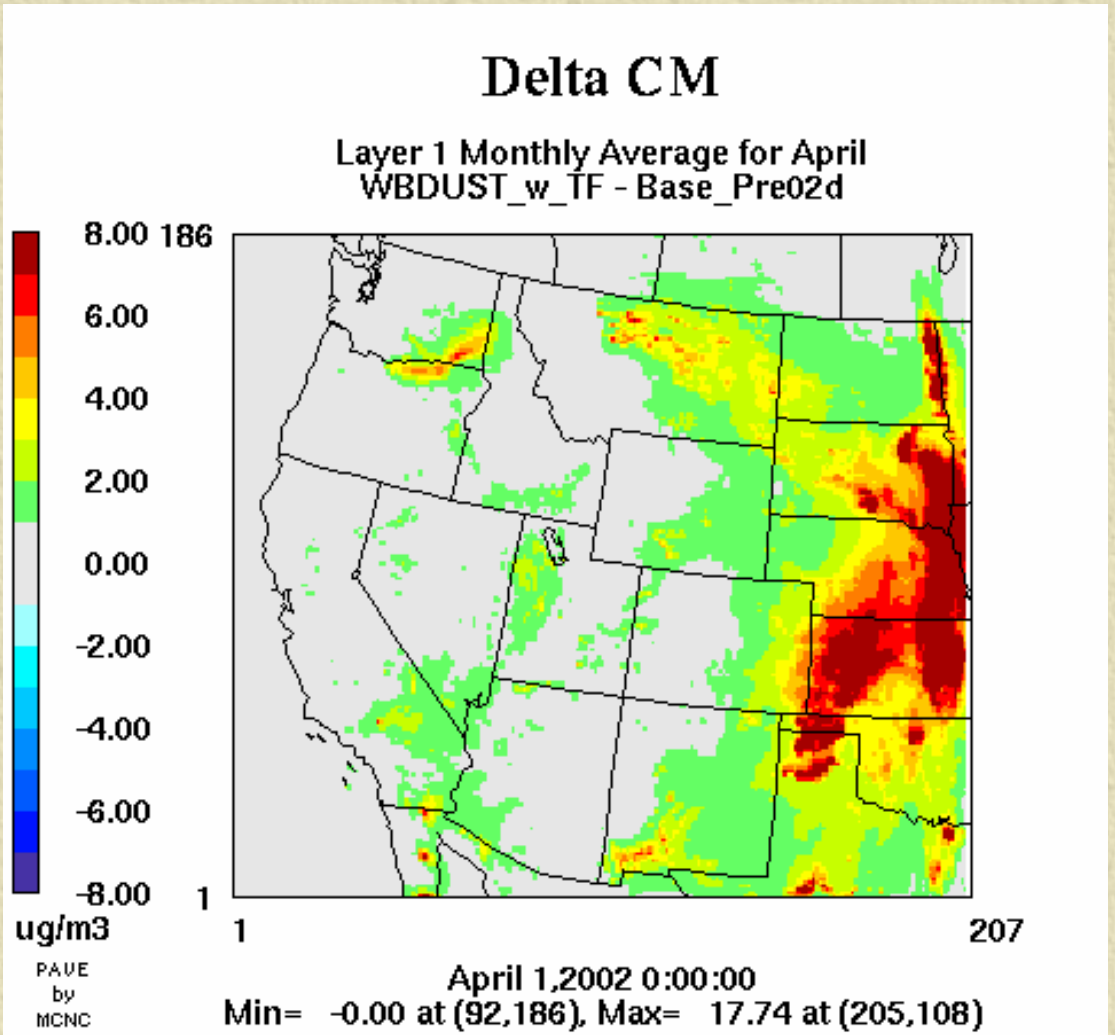
PM Fine Windblown Dust Densities



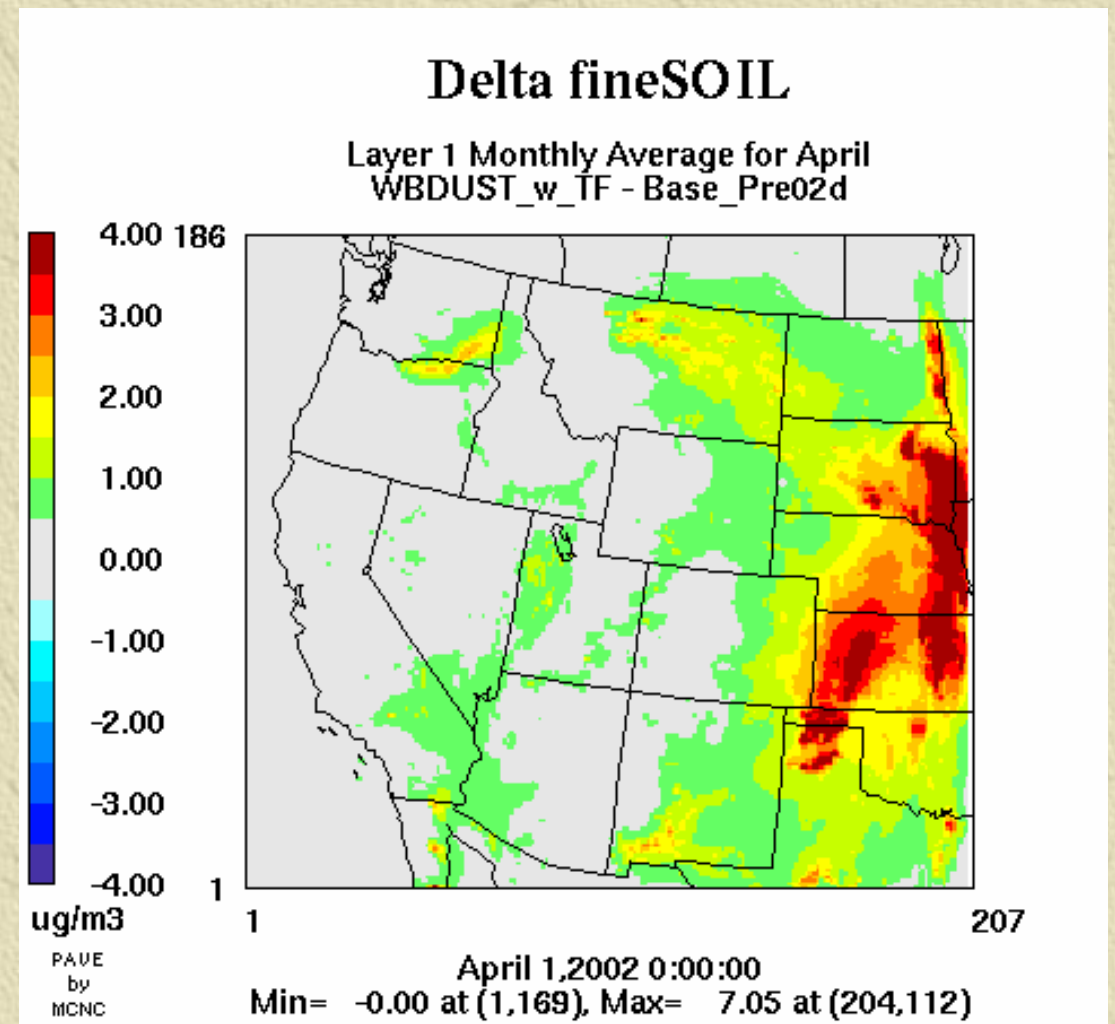
PM Fine Windblown Dust Densities



Coarse Dust PM w/ Transport Fractions



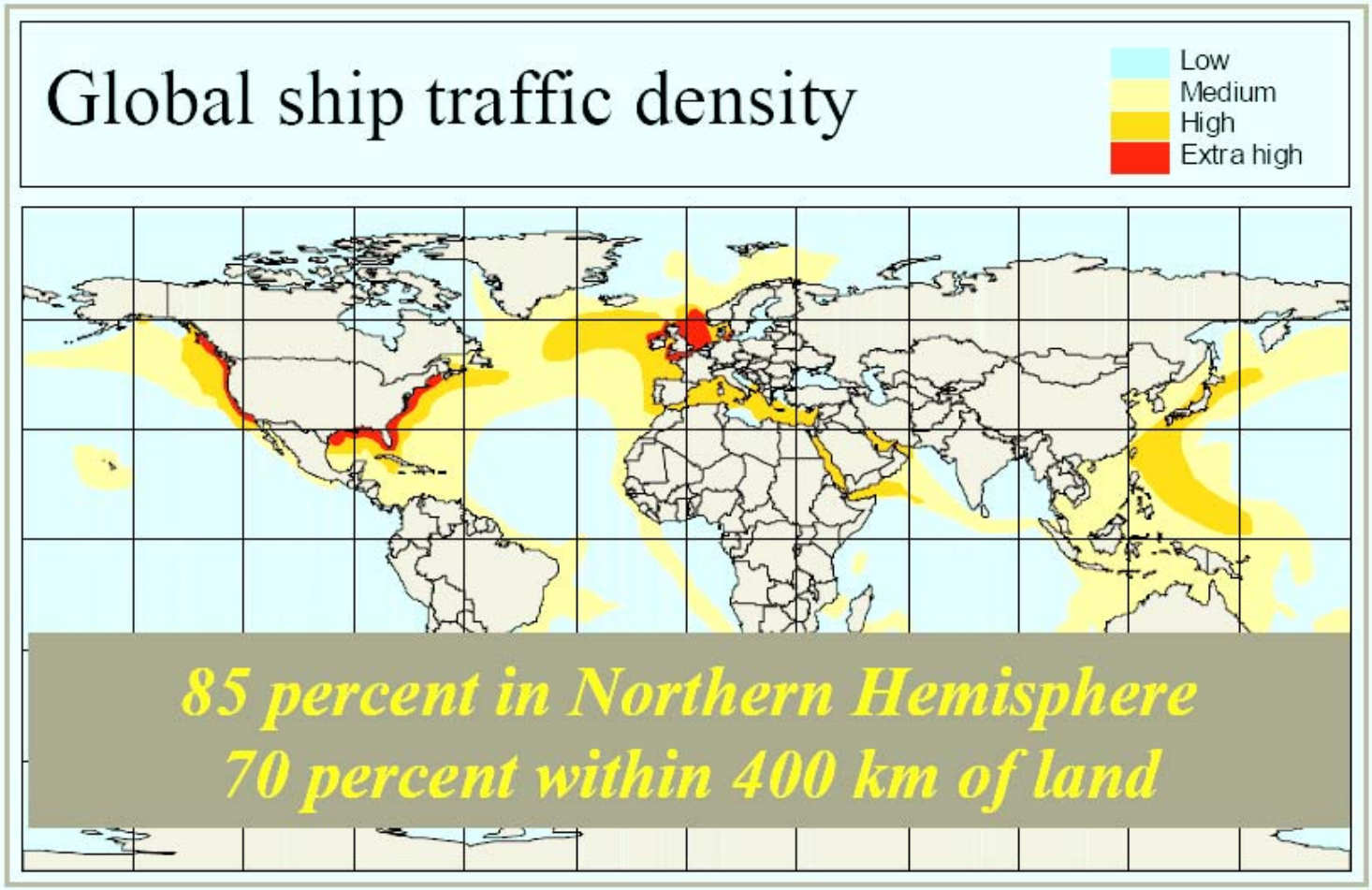
Fine Dust PM w/ Transport Fractions



Future Sensitivity Work

- Off-Shore Commercial Marine
- Small fires
- Fire plume rise
- More Dust work
- Others?

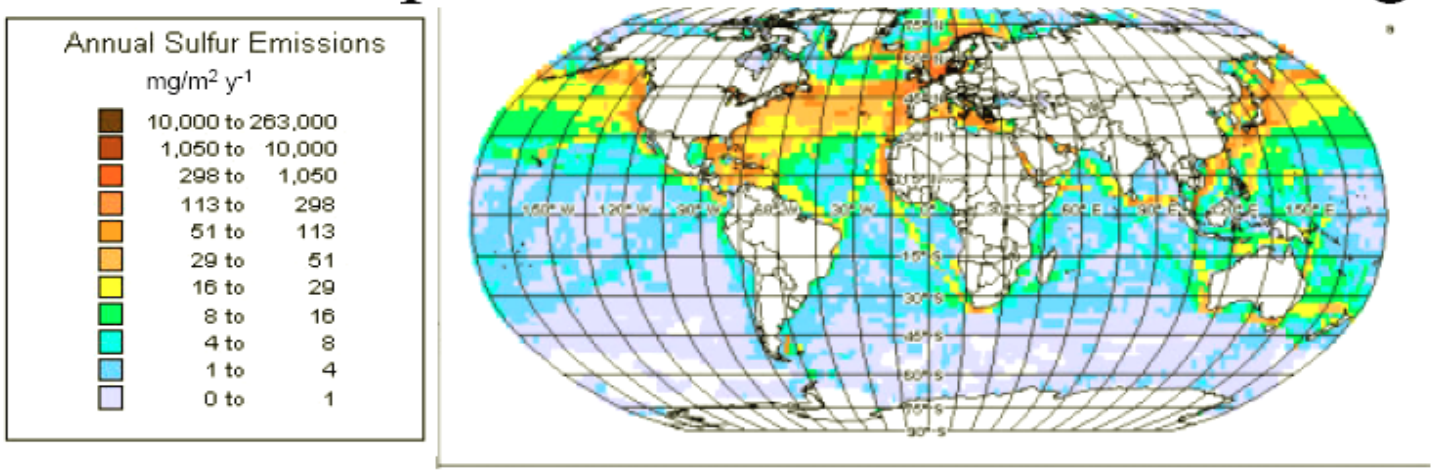
Off-Shore Shipping Emissions Inventory Source Data



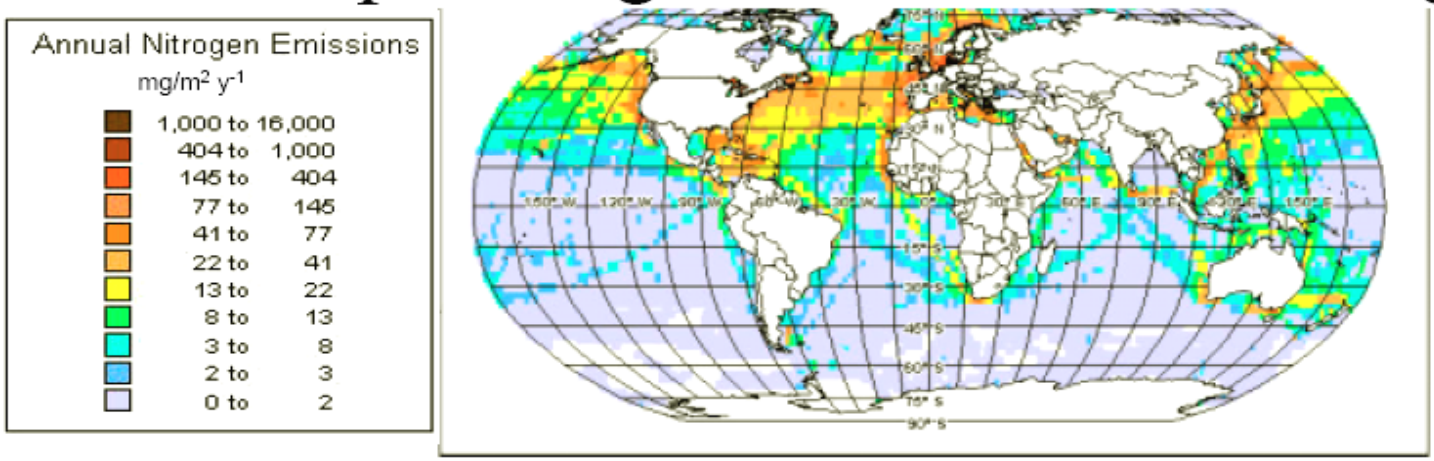
Source: IMO Study on Greenhouse Gas Emissions from Ships, MEPC 45(8), 2000.

Off-Shore Shipping Emissions

Global Ship Sulfur Emissions: 4.24 Tg/yr



Global Ship Nitrogen Emissions: 3.08 Tg/yr



Source: Corbett and Fischbeck, JGR, 1999

Fire Sensitivity Modeling

- **Visibility impacts of small fires – subtracted from all fires:**
  - **What level of fire activity needs to be tracked?**
  - **How does the model respond?**
- **Impacts of small fires – subtracted from all fires:**
  - **Less than ~100 acres, considering fuel loading/emissions**
  - **Less than ~50 acres, considering fuel loading/emissions**
- **Fire plume rise:**
  - **FEJF “hard-wired” vs. SMOKE “event-specific” approach**
  - **Will consider fuel loading and amount of emissions above Layer 1**
  - **Will test actual 2002 fire data for 5-10 selected events**