Atmospheric Pollution

(Tracking and Modeling Atmospheric Contaminants)

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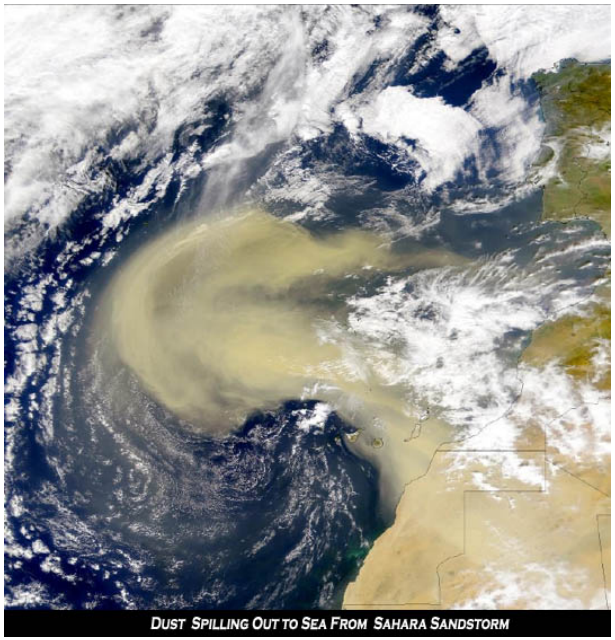
The ubiquitous nature of atmospheric turbulence



A multi-attribute phenomenon

- Multi-consequence
  - Weather
  - Climate (Global warming)
  - Health impact (Aerosols, chemicals)
- Multi-scale
- Multi-disciplinary

What has been achieved

And why it is so little

Fate of contaminant

$\Uparrow$

Modeling capability

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GeoSpatial and GeoTemporal Information

Concerted development effort

- Transport and dispersion models
- Meteorological models
- High performance computing
- Data mining
- Data assimilation

How much has been solved

- Model uncertainties assessment
- Probabilistic approach
- Ensemble modeling
- Crude statistical estimates
- Time and space scale definitions

On the right track?

How to measure progress

Not only science

- Continuous development of forecast models
- Expansion of GeoSpatial and GeoTemporal data collection and availability
- Broader users and developers base
- The communication problem
  - Informatics advances
  - Information availability
- Increased awareness and funding

On the wrong track?

How to measure failure

The pitfalls of heuristics

- No unified model
- Data mining is still a science
- Predictions are still made by scientists
- Basic science suffered from operational needs
- Basic science suffered from commercial interests
- Basic science suffered from lack of commercial interests

Neglected areas

Unpredictability of research directions

Not on the radar

- Cross-discipline mutual benefits
- Link between observation, field experiment, laboratory, and theory
- Multi-scale coordinated development

Future directions

Redefining priorities

Science and society needs

- Basic science investment (very high risk)
  - Turbulence closures and parameterizations
  - Mixing, transport and dispersion theory
  - Spatial and temporal fluctuations
- Centralized GeoSpatial and GeoTemporal data fusion
- GeoSpatial and GeoTemporal data assimilation
- Tracking and monitoring air quality and environmental indices
- Space and time scale harmonization
  - From atmospheric layers to molecular dynamics
- New cross-disciplinary paradigms
  - Rethinking and expanding the chain from society needs to scientific response