

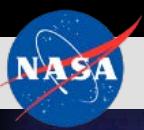


Temporal and spatial dynamics of atmospheric NO₂ in heavily polluted coastal regions

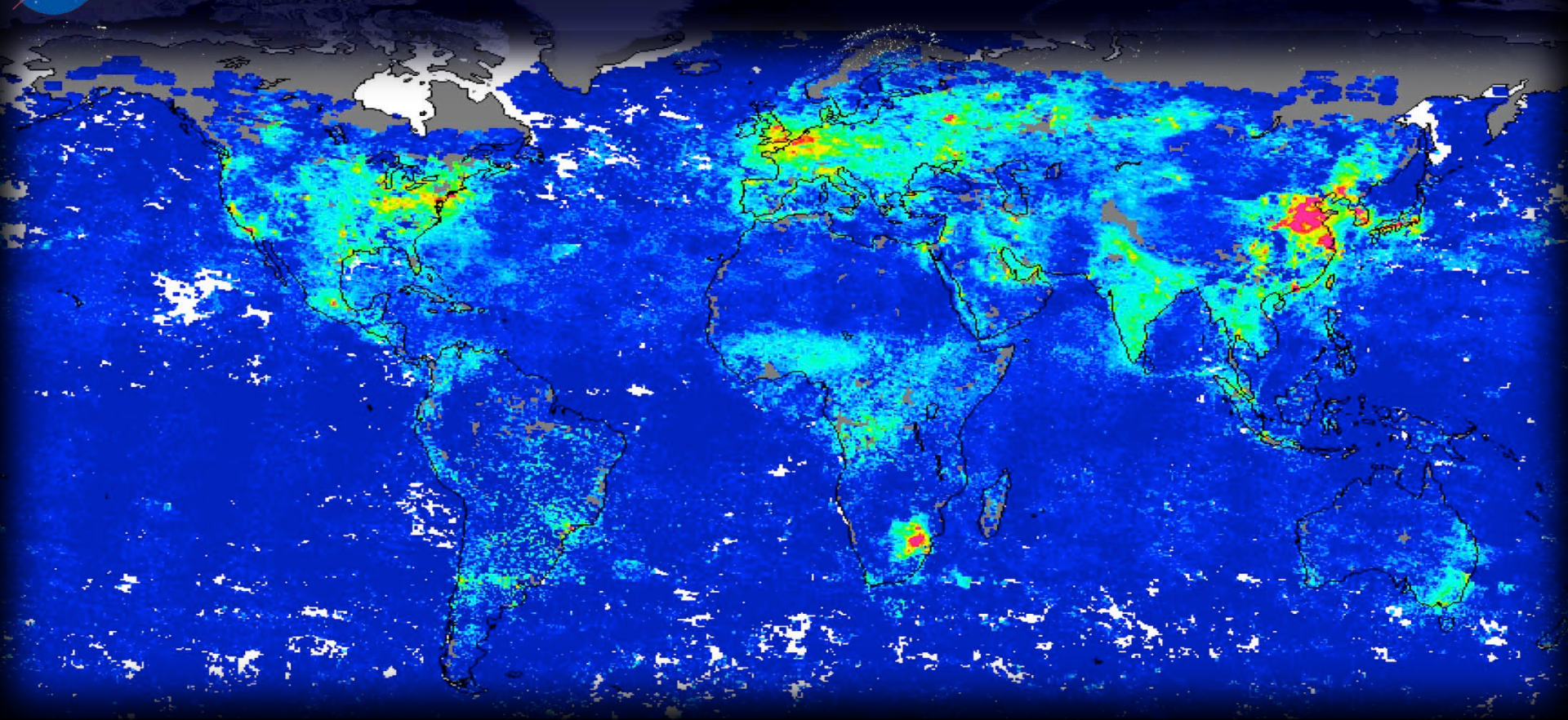
Maria Tzortziou, Owen Parker, Brian Lamb, Nader Abuhassan

City University of New York and Columbia University/LDEO, NASA Goddard Space Flight Center





Why measurements from shipboard Pandoras



Shipboard Pandora measurements are needed to:

1. Capture **spatial and temporal variability in atmospheric composition** at the land-water interface
2. Characterize impacts of meteorological processes, such as sea breezes, on **accumulation of pollutants over coastal environments**
3. Quantify **impacts of atmospheric trace gases/aerosols on satellite** retrievals of coastal ocean biology and biogeochemistry
4. Assess impacts of atmospheric pollution and **deposition of pollutants on coastal ecosystems**



Korean- US (KORUS) Oceanographic Field Campaign





Korean- US (KORUS) Oceanographic Field Campaign

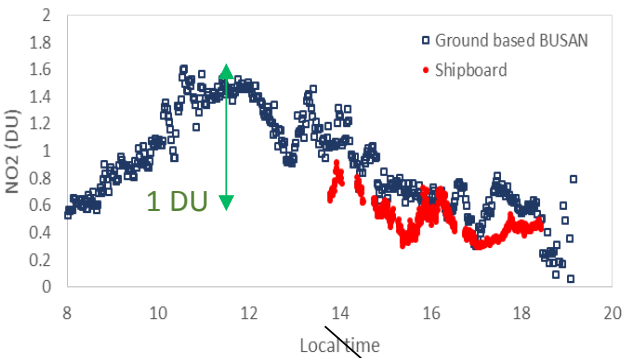




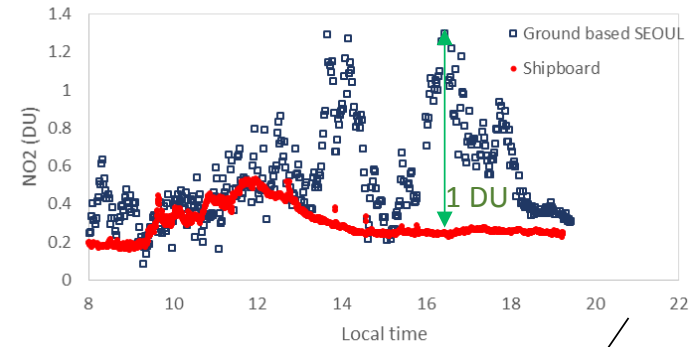
Atmospheric NO₂ dynamics in South Korean coastal waters

- High **temporal and spatial variability** in atmospheric O₃ and NO₂ across these coastal waters
- Large spatial gradients in NO₂ column during approach to **urban regions, with TCNO2 exceeding 0.5 DU, even at > 50 km distance from shoreline**
- NO₂ column showed strong **diurnal variability** at held position in Busan and offshore Seoul
- Shipboard Pandora consistent with ground-based network, but different diurnal variability over the ocean

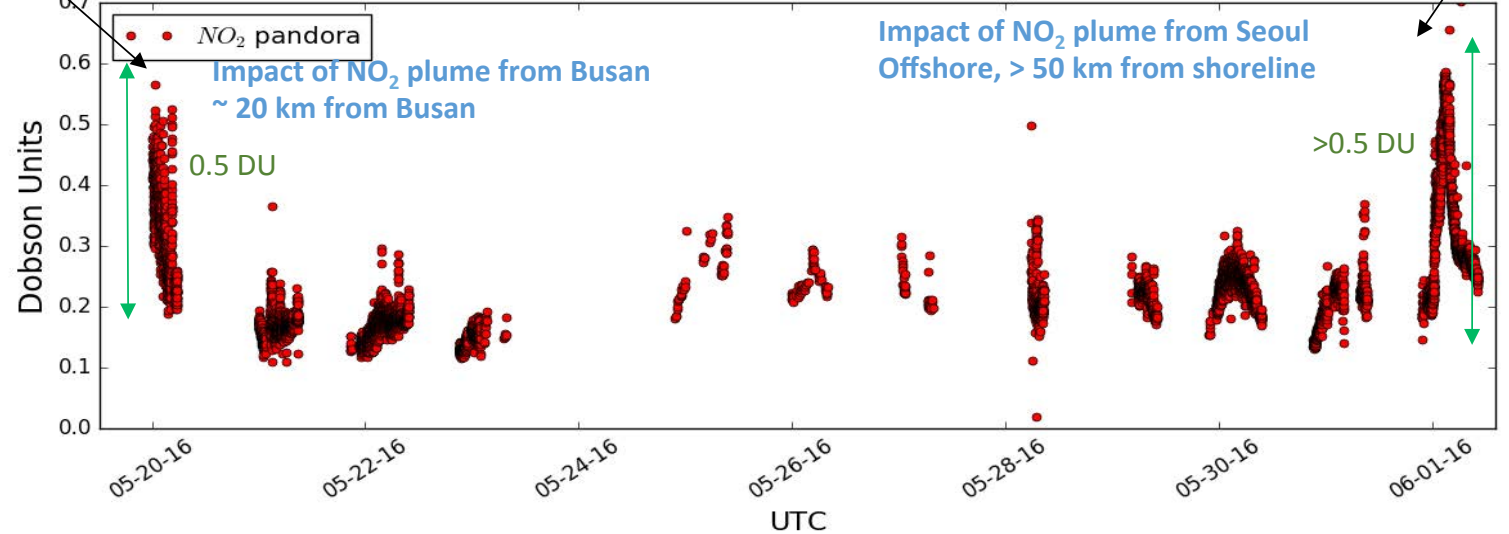
Busan, 18 May 2016



Seoul, 1 June 2016

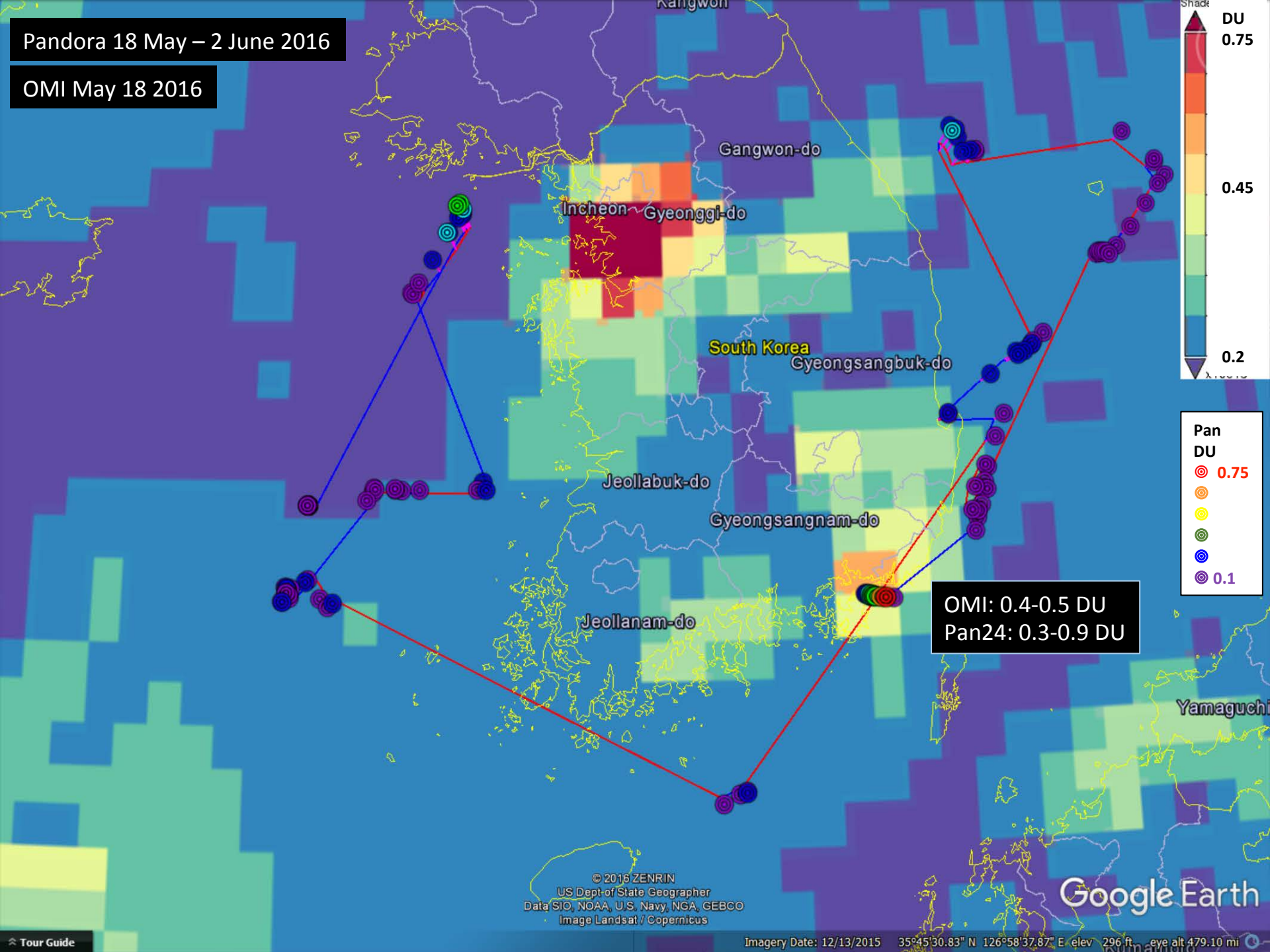


Pandora: Total Column NO₂



Pandora 18 May – 2 June 2016

OMI May 18 2016





In Summary

- **NO₂ at ground based Pandora stations** near coastal waters, although consistent with NO₂ measurements over the coastal ocean, do not show always same diurnal patterns
- **Satellite OMI retrievals** underestimate NO₂ near hotspots, overestimate NO₂ in 'rural'/clean areas, and do not capture spatial/temporal variability relevant to GEO-CAPE/GOCI OC (~300-500 m spatial resolution; diurnal variability)
- **NO₂ over the ocean can be highly variable**; During KORUS-OC, TCNO₂ reached 0.9 DU near Busan, and >0.5 DU offshore Seoul (>50 km). This has major implications for **atmospheric correction of coastal ocean color retrievals**. Dry deposition of this N-pollution over coastal ecosystems, such as tidal wetlands, can have **major ecological implications**.
- **More measurements of atmospheric NO₂ over the coastal ocean are needed**, to monitor impacts of air pollution on coastal ocean color retrievals and assess atmospheric composition variability across terrestrial-aquatic interfaces



NASA CBODAQ (July 2011)



NASA/KIOST KORUS OC (summer 2016)



NASA GOMEX (September 2013)



NASA/EPA Chesapeake Bay (summer 2017)