#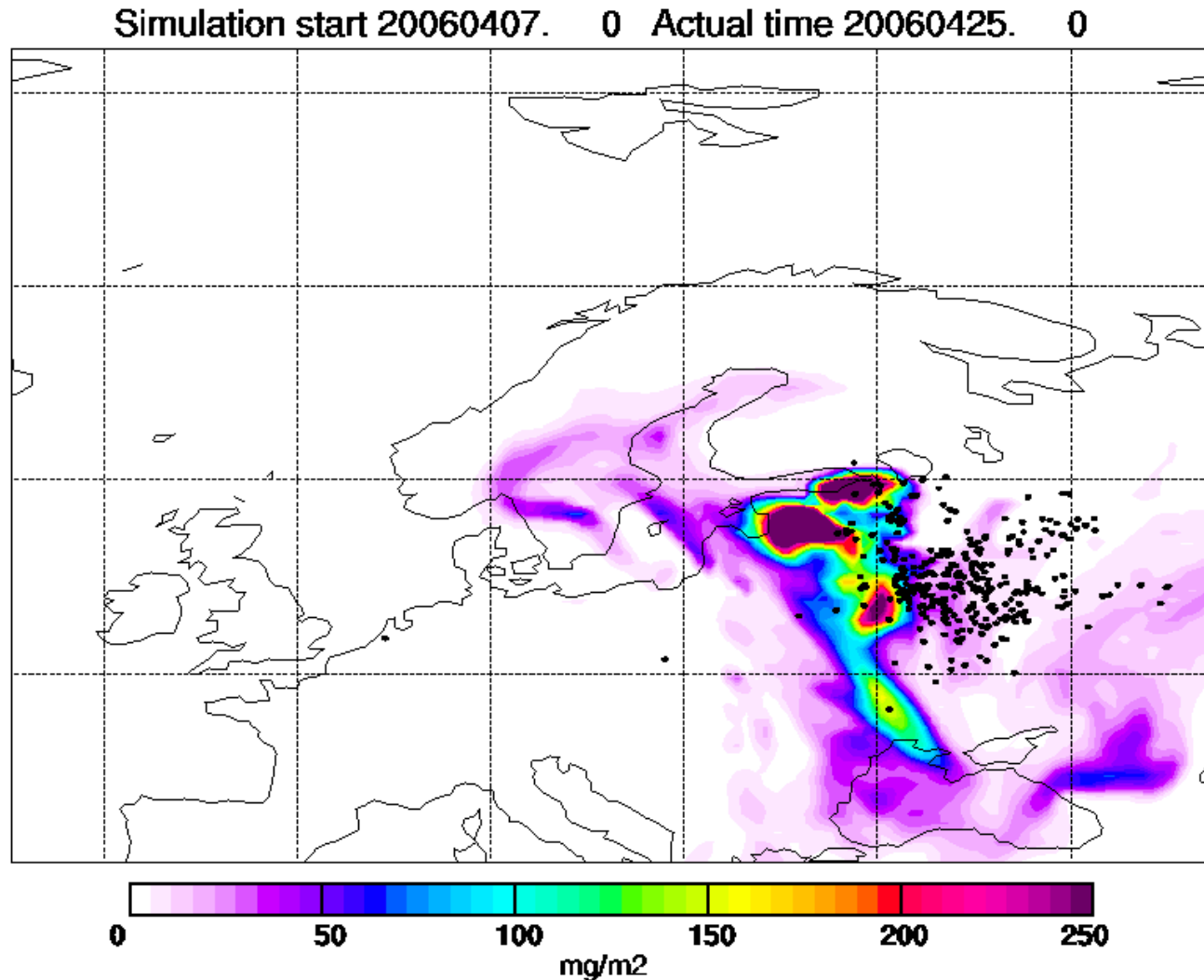 *Elimination of Fire Use in Agriculture: How a Multi-disciplinary Approach Can Lead to Better Land and Water Resource Management*

RINGO Presentation to Koronivia Workshop
Pam Pearson, Director, ICCI;
Co-chair CCAC Agriculture Initiative 2015-21

www.iccinet.org
www.openburning.org

Satellite Imaging Documents Far-reaching Fire Impacts (NILU animation, Stohl et al 2006)

Simulation start 20060407.　0　Actual time 20060425.　0

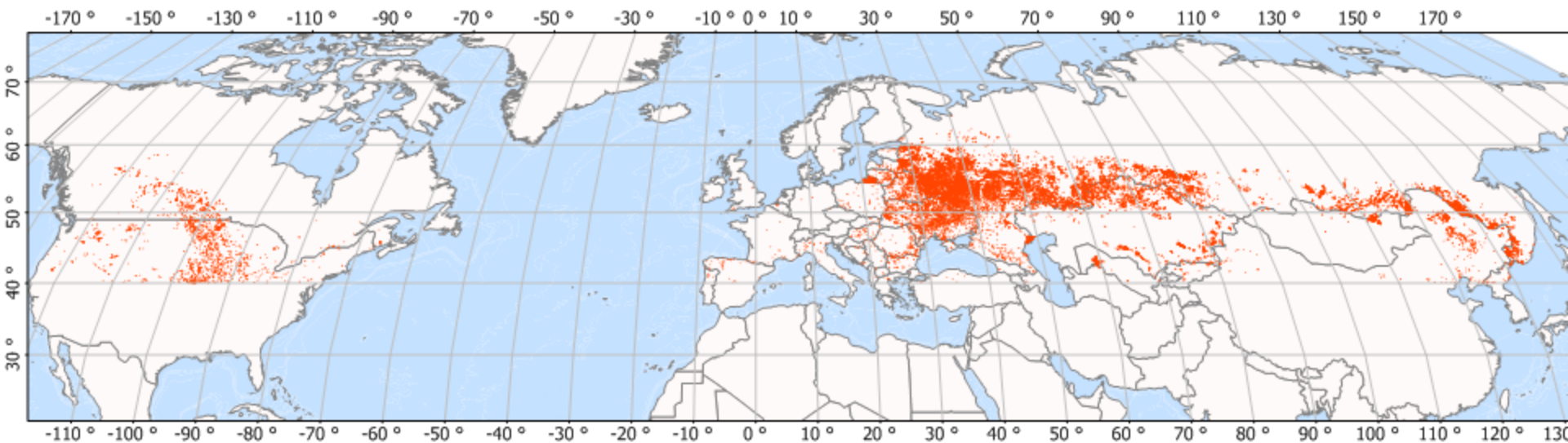0　　　　50　　　　100　　　　150　　　　200　　　　250

mg/m2

Extreme Air Pollution

Picture courtesy: Ann-Christine Engvall

Agricultural Fires* - April 2006

*all fires north of 40N Latitude

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Fire Use in Agriculture:
How a Multi-disciplinary Approach Identified a Problem (and even some solutions)

➢ **Mapping of fires to detect reality-based patterns (not anecdotal)**

➢ **Outreach to farmers: Why do these lands and farmers burn? Purpose of fire use? Perverse incentives?**

➢ **Outreach to academia: Impacts – Crop yields? Land, water? Health? Climate?**

➢ **Outreach to governments, IGOs: what's been tried? Successes, failures?**

Over past decade, working with the above plus development agencies, national + sub-national governments, identified cascading impacts on lands, waters, biodiversity, human health -- and climate

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Accurately Defining the Problem

- **Use of fire for any purpose in agro-forestry sector:**
  - ✓ **Burning of crop stubble prior to next planting** (Stereotype, and often only category included in models)
  - ✓ **Clearing of weeds/parasites in fields or orchards**
  - ✓ **Clearing of land for cultivation ("first use;" reclamation; slash-and-burn)**
  - ✓ **Pasture/savannah burning to "renew" grass**
  - ✓ **Clearing of understory prior to lumber harvest**
  - ✓ **WILDFIRES THAT SPREAD FROM THE ABOVE (emissions inventories have yet to include)**
- **Important: Does NOT include prescribed burns on wildlands or emergency fire prevention**

Land Management Impacts

- **Long-known impacts on humus (1930's Soviet studies)**
- **Soil "burns" as well as biomass: leads to brittle, dry soil**
- **Brittle soil easily erodes (wind and water, "Dust Bowl")**
- **Decreases soil fertility and crop yields by 25-30% (excessive use of fertilizer masks in most studies)**
- **Corresponding 25-35% greater fertilizer use needed to compensate lower soil fertility and maintain yields (UC-Davis studies during transition to no-burn early 2000's)**
- **Added fertilizer → increased ammonia (PM2,5 pollution (health), N2O (climate)**
- **Cycle repeats, with more and more layers of soil lost**

Water Management Impacts

- **Brittle burned soils less able to hold moisture**
- **Greater need for irrigation and water use**
- **More prone to water erosion and fertilizer run-off**
- **Greater use of fertilizer (due to decreased soil fertility)**
- **In warming climate with weather extremes (drought, but also hard and more prolonged rain events) soil is less resilient**

- **More brittle soils and fertilizer use → More erosion, run-off and water pollution**
- **Less water available for other purposes**

Wildfire Spread from Set Ag Fires:
Direct Infrastructure Loss and Damage, Mortality

1) Most wildfires of human origin -- large portion (and perhaps majority) from set agricultural fires

2) Wildfires spread from set agricultural fires compound other impacts:

- Loss of nearby forest and pastureland resources
- Loss of biodiversity in burned areas
- Infrastructure loss and damage (homes, businesses)
- Loss of life -- direct, traffic accidents (poor visibility), firefighting
- Wildfires extremely "hot," inject pollution into atmosphere, resulting in greater spread/trans-boundary impacts

Health Impacts

- **Fire key source of air pollution, even in OECD nations as other sources (energy, diesel transport) come under greater control**

- **Large impacts due to scale, even if occurs only once-twice per year**

- **Health impacts worse combined with heat/increasing temps**
  - ✓ **Higher mortality from respiratory or cardiac illness, especially among young and elderly**
  - ✓ **Higher morbidity, including long after even single fire events from chronic respiratory illness (asthma)**
  - ✓ **Increased mortality/morbidity due to accidents**
  - ✓ **Worse in rural populations, but increasingly urban**

New Delhi, October 2018

Photo from NPR,

Climate Impacts

- **Emissions and impacts travel (regional/hemisphere)**
- **Agricultural fires and related wildfires release CO_2, methane, PM2,5 including black carbon**
- **Not "carbon-neutral" due to loss of carbon from burned soil, even with annual re-planting**
- **Fires comprise the largest single source of black carbon globally (36%), largely human origin and largely agricultural + forestry sectors**
- **Fires close to cryosphere = feedback into more intense regional warming/glacier and snow melt (measurable change last year in**

Multi-disciplinary Solutions

➢ **Used successfully at demonstration level in a variety of agro-economic systems: from Russia (large commercial farms) to subsistence indigenous community farming in Andean Peru**

➢ **Step 1 (Always!): Mapping of fires going back at least a decade to detect most important patterns in fire use**

➢ **Outreach to farmers, local academics, governments, IGOs: Why do these lands and farmers burn? Alternatives to that specific need and use?**

➢ **Demonstration projects oriented to largest fire sources – show it can be done at local level – combined with policy work with local/national governments.**

➢ **Detailed continuous and follow-up mapping to confirm fire not being used in demonstration sites**

➢ **Next step: climate and ODA financing**

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Demonstration Plot Peru:
Burned Plot (right) and Fire-free CA (left)

Combined Benefits of Fire-free Ag: Adaptation + Mitigation

- Low-till and especially, no-till essential to adaptation
- Holds moisture during drought, holds soil during extreme rains
- Preserves water resources and less water pollution from fertilizer and erosion in time of water scarcity
- More reliable yields in changing climate
- "Negative emissions" and carbon drawdown (IPCC SR on Lands)
- Continually burned soils CANNOT be a carbon sink – but converting regularly burned soils to fire-free may be powerful source of negative emissions

Better Monitoring Technology:
Better Tracking of Sources and Emissions

- **New VIIRS satellite mapping captures 4-6x more fires than older MODIS satellites**

- **VIIRS can differentiate crops and burning conditions (plant mass, dry/wet), with more reliable emissions estimates**

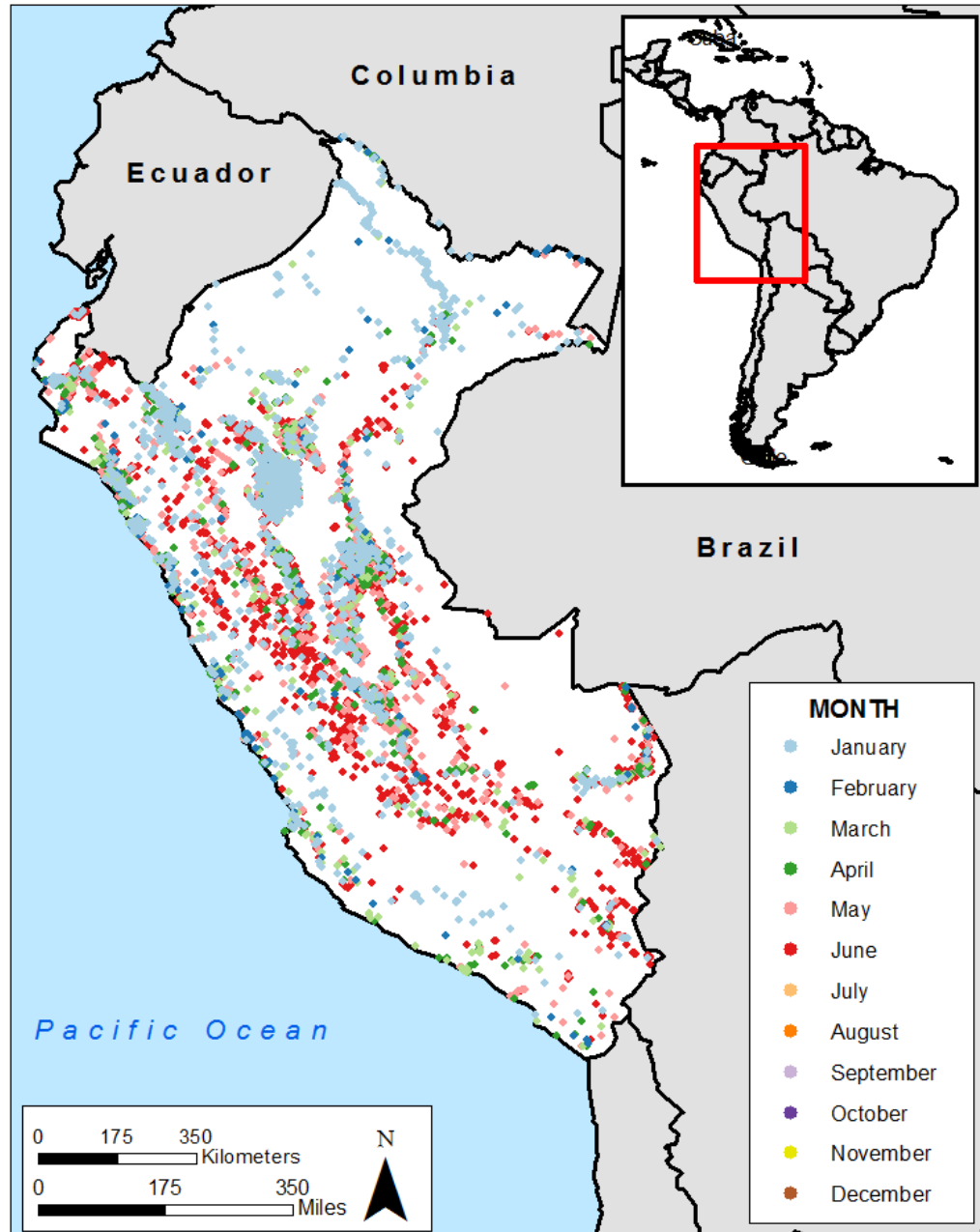- **Private sector "mini" satellites becoming even more powerful tool**

Peru, 2015-17 from VIIRS
(compare with total 159,000,000 Mt CO2 in 2012):

YEAR	Black Carbon Mt	CO2 Mt	CH4 Mt	PM2.5 Mt
2015	54,605	170,856,059	537,797	940,285
2016	64,944	203,061,615	640,856	1,121,869
2017	45,189	141,136,684	446,023	772,418

VIIRS Active Fire Detections in Peru

JAN - JUN 2016 Detected Fires; Total Fires = 10,100

Columbia

Ecuador

Brazil

Pacific Ocean

MONTH
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

0 175 350
Kilometers

0 175 350
Miles

N

VIIRS Active Fire Detections in Peru

JUL - DEC 2016 Detected Fires; Total Fires = 85,333

Columbia

Ecuador

Brazil

Pacific Ocean

MONTH

- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

0	175	350
Kilometers

0	175	350
Miles

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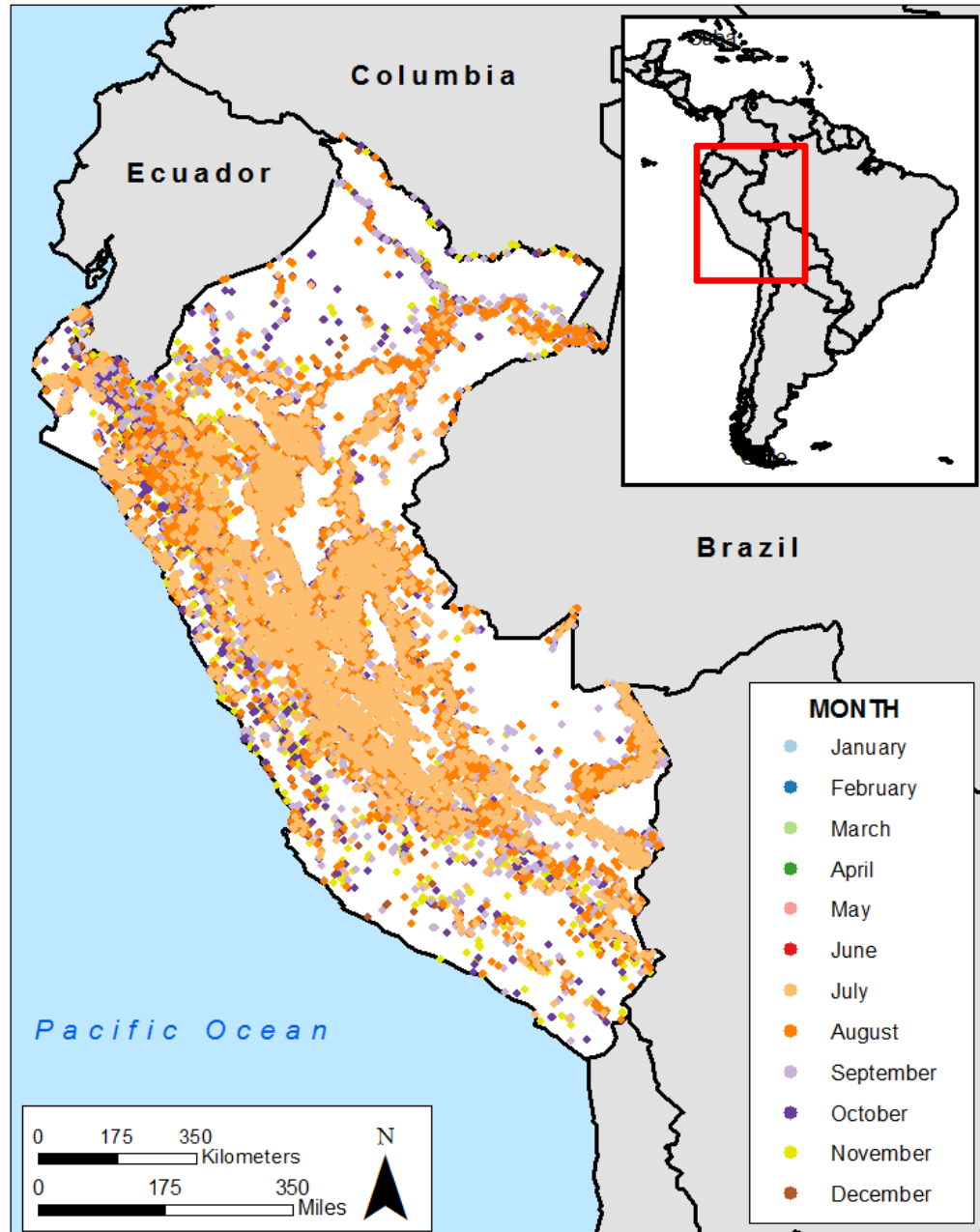
Some Fire-free Alternatives

➢ **GOOD ALTERNATIVES EXIST: Fire-free methods proven across the agricultural sector to increase yields/profits.**

➢ **Crop Stubble:**

  • **Low-Till: Incorporate stubble into soil**

  • **No-till/direct seed: Plant through stubble**

  • **Conservation agriculture: adds cover crops, manure**

  • **"Harvest" and monetize straw: for bedding, pellets, bricks**

➢ **Clearing Understory: Mechanical removal and incorporation or production of wood chips**

➢ **Pasture: Harvest for hay (burning does not "fertilize")**

➢ **FARMER EDUCATION, INCENTIVES KEY and may include micro-financing**

Takeaways

- **FIRE-FREE ALTERNATIVES SUPPORT SDG GOALS: food security, greater economic security, adaptation/resilience, cleaner water, family health, soil and climate all benefit**

- **MAP AND ASK: Don't assume fire use not occuring**

- **DON'T DEMONIZE THE FARMER: No farmer "likes" to burn, but lack reliable alternatives and support for transition**

- **RESPECT THE FARMER: Don't fall back on "farmers will always burn, so just teach them to 'burn better' "**

- **CHANGE CAN COME QUICKLY: Example of Baltics/Poland with EU accession support; Argentina/Eastern Bolivia as became aware of greater profits with no-till practices**

International Cryosphere Climate Initiative

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FAO
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NEFCO
Climate and Clean Air Coalition and UNEP
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