Report for the year 2016 and future activities

SOLAS ‘INDIA’
compiled by: ‘VVSS Sarma’

This report has two parts:

- Part 1: reporting of activities in the period of January 2016 – Mar-Apr 2017

The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan.

IMPORTANT: May we remind you that this report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups, cities)!

PART 1 - Activities from January 2016 to Jan/Feb 2017

1. Scientific highlight

Describe one scientific highlight with a title, text (max. 200 words), a figure with legend and full references. Please focus on a result that would not have happened without SOLAS, and we are most interested in international collaboration. (If you wish to put more than one, feel free to do so).

Orography and meteorological factors facilitate increase in finer particles over Visakhapatnam ‘bowl’ area

Amount of fine particles in air is of concern because of its potential hazard to human health. It is not yet mandatory to monitor PM$_{2.5}$ (particles<2.5 µm) levels in our country and therefore very limited information is available on its amounts and distributions. It is also important to study air particles of other sizes and the role of meteorological and other topographic conditions in determining the particle concentrations and variations. We report here abundances and changes in PM$_{2.5}$, PM$_{10}$ (particles<10 µm) and PM>10 (particles >10 µm) sized particles during winter and transition to summer periods in the Visakhapatnam city to examine the potential sources and influence of unique orographic features of the city. Our results suggest the occurrence of alarming levels of PM$_{2.5}$, and PM$_{10}$ that will have serious implications to respiratory issues and lung diseases. Despite less populated and low industrial activities in Visakhapatnam, the concentration of PM$_{2.5}$ and PM$_{10}$ were higher than other major Indian coastal cities (eg: Mumbai, Kolkata and Chennai), which are heavily populated as well as industrially active cities. Visakhapatnam city has a unique orography (bowl shape, surrounded by hill ranges) and atmospheric temperature inversion during winter limits the transport of particles, therefore, increases the particle residence time over the city. Relations of particles abundances with meteorological properties revealed that increase in temperature and winds blowing from southwest facilitate transport of particles from the industrialized hub to the ‘bowl’ area and the prevalence of finer particles aided by poor flushing due to orography. This study highlights the dominant effect of orography over other factors and potential impacts of fine particles on human health of the city.

Table 1 — Ratio of PM$_{2.5}$ and PM$_{10}$ at different geographical locations

<table>
<thead>
<tr>
<th>Location</th>
<th>PM$_{2.5}$(µgm$^{-3}$)</th>
<th>PM$_{10}$(µgm$^{-3}$)</th>
<th>PM$<em>{2.5}$/PM$</em>{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>25</td>
<td>40</td>
<td>0.61</td>
</tr>
<tr>
<td>Spain</td>
<td>17</td>
<td>28</td>
<td>0.63</td>
</tr>
</tbody>
</table>
Yadav et al., 2017, Current Science, in review

Influence of atmospheric dry deposition of inorganic nutrients on phytoplankton biomass in the coastal Bay of Bengal

The aerosols from continents contain relatively higher amounts of inorganic nutrients than those of marine origin and can make a notable contribution to the coastal biological productivity. To test this hypothesis, the composition of aerosols over the city of Visakhapatnam (central east coast of India) were studied when continental flow was dominant and its impact on phytoplankton biomass was estimated through microcosm experiments between September 2013 and November 2014. Higher nitrate (NO$_3^-$) and ammonium (NH$_4^+$) concentrations were observed in the aerosols collected in January while higher phosphate (PO$_4^{3-}$) was observed in September. Simultaneous observations of aerosols over the city and neighboring coastal waters revealed that the concentrations of nitrate in ambient aerosols ranged from 0.56 to 1.89 µg m$^{-3}$ and 0.09 to 0.86 µg m$^{-3}$, respectively. Our results suggest that 52-89% of city’s aerosols borne nitrogen deposited over waters within 10 km from the coastline. Microcosm experiments were conducted by spiking the surface water samples, collected from the coastal Bay of Bengal (BoB), with the dust borne nutrients. Upon spiking, dissolved inorganic nitrogen (NO$_3^- +$ NH$_4^+$) increased from 0.3 to 11.7 µmol L$^{-1}$ and the N:P ratio increased from 2 to 97. This led to enhanced phytoplankton to 4 times) upon spiking. The increase in phytoplankton biomass was linearly related to ratios in water as aerosol deposition increased the N: P ratios in the microcosms, leading to growth. Though aerosols did not contribute to bioavailable silicate, our microcosm showed linear relationships between ambient silicate phytoplankton biomass, and of Fucoxanthin (a marker pigment for diatoms). This indicates that the availability of silicate facilitated dominant diatom growth in the presence of higher N: P ratios due to aerosol deposition of soluble aerosol nitrogen appears to support ~3 to 33% of the biological the coastal waters off Visakhapatnam with higher contribution in winter (~33%) than in summer. This study suggests that atmospheric deposition of nutrients enhances phytoplankton growth along the central east coast of India during the winter monsoon period, in particular, the hypothesis stated above.
Atmospheric dust acidifies coastal Bay of Bengal and enhances CO₂ flux to the atmosphere

Enhanced atmospheric deposition of nitrogen and sulphur due to anthropogenic activities may acidify coastal waters and change direction of CO₂ exchange at air-sea interface. In order to test this hypothesis, simultaneous observations of atmospheric dust and coastal water pH was measured over two years at weekly and monthly intervals respectively to examine the impact of atmospheric deposition on surface water pH. The composition of atmospheric dust over study region suggests significant contribution of acidic aerosols, such as sulphates and nitrates and their concentrations were relatively higher during winter followed by spring and summer. The mean [NO₃⁻/SO₄²⁻] ratio in the study region (0.8±0.2) suggests greater contribution of SO₄²⁻ from stationary sources (industrial activities) over vehicular activity. The acidity of the anions was not balanced during winter while closer balance occurred during other seasons. The atmospheric deposition of aerosols relatively decreased more pH of surface seawater during winter (0.020±0.003) than summer (0.011±0.003) and spring (0.007±0.002) and it is consistent with the concentrations of sulphate and nitrate in the dust deposited. The decrease in pH due to atmospheric deposition of dust elevated pCO₂ levels by 5.1 to 19.7 µatm resulting in enhanced CO₂ flux (by 0.12 to 0.54 mmol m⁻² d⁻¹) to the atmosphere from the coastal Bay of Bengal. This study suggests that atmospheric deposition has significant impact on acidification of coastal Bay of Bengal, however, its impact on ecosystem needs integrated studies.
Figure: Weekly variations in concentrations of TSP (µg/m³/d) (top panel) and change in pH due to dissolution of 1 µg/m³/d of atmospheric dust to one liter of filtered (0.2 µm) surface seawater.

Kumari et al., 2017. Tellus-B, submitted

Carbon isotope-constrained seasonality of carbonaceous aerosol sources from an urban location (Kanpur) in the Indo-Gangetic Plain: 14C apportionment of carbonaceous aerosol

The Indo-Gangetic Plain (IGP) in northern India, Pakistan and Bangladesh is a major source of carbonaceous aerosols in South Asia. However, poorly constrained seasonality of their sources over the IGP leads to large uncertainty in climate and health effects. Here, we present a first dataset for year-round radiocarbon (¹⁴C) and stable carbon (δ¹³C) based source apportionment of total carbon (TC) in ambient PM10 collected from an urban site (Kanpur: 26.5N, 80.3E) in the IGP during January 2007-January 2008. The year-round ¹⁴C based fraction biomass (fbio-TC) estimate at Kanpur averages ~77±7%, emphasize an impact of biomass burning emissions (BBEs). The highest fbio-TC (%) is observed in fall season (October-November: 85±6%) followed by winter (December-February: 80±8%) and spring (March-May: 75±8%), while lowest values found in summer (June-September: 69±2%). Since biomass/coal combustion and vehicular emissions mostly contribute to carbonaceous aerosols over the IGB, we predict δ13CTC (δ13TCpred) over Kanpur using nown δ13C source signatures and the measured Δ14C value of each sample. The seasonal variability of δ13Cobs-δ13Cpred versus Δ14CTC together with air mass back trajectories and MODIS fire count data reveal that carbonaceous aerosols in winter/fall are significantly influenced by atmospheric aging (downwind transport of crop-residue burning/wood combustion emissions in the northern IGP), while local sources (wheat residue combustion/vehicular emissions) dominate in spring/summer. Given the large temporal and seasonal variability in sources and emission strength of TC over the IGP, 14C-based constraints are, thus, crucial for reducing their uncertainties in carbonaceous aerosol budgets in climate models.


2. Activities/main accomplishments in 2016 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, etc.)

Two projects (GEOTRACES and Ocean finder) have been completed. However, we are anticipating extension of GEOTRACES project for another 5 years.

3. Top 5 publications in 2016 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.


Jickells TD, Buitenhuis E, Altieri KE et al. 2017. A re-evaluation of the magnitude and impacts of
anthropogenic atmospheric nitrogen inputs on the ocean: Duce et al revisited, Global Biogeochemical cycles, doi: 10.1002/2016GB005586


For journal articles please follow the proposed format:
Author list (surname and initials, one space but no full stops between initials), year of publication, article title, full title of journal (italics), volume, page numbers, DOI.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2016? If yes, who? How did you engage?
No
In India, we are at the end of five year plan (2012-2017) and all existing projects have been closed and new proposals are under review.

4. Plans / ideas for future projects, programmes, proposals national or international etc. (please precise to which funding agencies and a timing for submission is any)
A proposal entitled “Impact of atmospheric dust on coastal ecosystem” is proposed to Council of Scientific and Industrial Research (CSIR) for possible funding. This proposal is under review.

5. Engagements with other international projects, organisations, programmes etc.
No

Comments