Assessments of the anthropogenic radiative forcing over the Amazon Basin: Aerosols and land-use change

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Man-made biomass burning activities that occur yearly in the Amazon send large amounts of smoke to the atmosphere, and alter the landscape by converting forested areas into pastures and cropland. This work addresses the radiative forcing (RF) of the smoke aerosol and of the land cover change in Amazonia, seeking to quantify their climatic impact over the Earth System.

The cloud-free direct RF due to biomass burning aerosols was derived from the CERES sensor (Clouds and the Earth's Radiant Energy System) [1] flux retrievals over the Amazon from 2000 to 2009, considering the peak of the burning season from August to September. The Amazon Basin was divided in 0.5° latitude-longitude grid cells according to [2], and the broadband shortwave (0.3 to 5.0 μm) radiation flux was regressed against the aerosol optical depth to determine the radiative flux under clean (no aerosol) conditions, F_{cl}. The direct RF was derived by subtracting from F_{cl} the flux under average aerosol conditions. The resulting aerosol RF shows large spatial and temporal variations, with an average of -10.4±4.4 W/m^2 in a basin-wide scale, during the biomass burning season from 2000 to 2009. In local spatial scales and across the solar spectrum this figure can vary significantly. For instance, over the city of Alta Floresta, Brazil (-9.9°N, -56.0°E) for the 2007 burning season the cloud-free spectral direct aerosol RF was estimated as -57 W/m^2 at 440 nm, -17 W/m^2 at 675 nm, +11 W/m^2 at 870 nm, and +6 W/m^2 at 1020 nm.

The RF due to land-use (albedo) change was estimated for clean (no aerosol) conditions over the state of Rondonia, Brazil, an area that has been heavily deforested since the 70's. Surface reflectance retrievals from MODIS (Moderate Resolution Imaging Spectroradiometer) were used to select study areas, and the RF was computed as the difference between the CERES radiative flux at the top of the atmosphere above forests and over nearly bare-ground deforested patches. The albedo land-use change RF was -22±3 W/m^2, a figure that can be compared to the direct aerosol RF, but in the Amazon these deforestation patches correspond to a nearly permanent modification of the surface albedo that also changes the local radiation budget.

Studies of the indirect (i.e. mediated by clouds) aerosol forcing over the Amazon Basin are currently under way and they will help throwing in one more puzzle piece to the set above, depicting key factors that define the human RF over the Amazon.

[1] Wielicki *et al.* (1996) *Bull. Amer. Meteor. Soc.* **77(5)**, 853-868. [2] Patadia *et al.* (2008) *J. Geophys. Res* **113**, D12214.

Osmium isotope signatures in peridotites from the ultra-slow spreading SWIR and RTJ

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The ridge magmatic systems are the places where crust directly forms. They provide information on how different crust forms depending on variable spreading rates associated with amount of melt supply and the source of the supplied melts. The central part of the Southwest Indian Ridge (SWIR), known as an ultra-slow spreading system (14-16 mm/yr) was investigated. We had two cruises of R/V Hakuho-Maru in 2008 (KH07-4 Leg2) and 2010 (KH09-5 Leg4) R/V Hakuho-Maru and dredged aphyric to porphyritic basalts, peridotites, metamorphic and sedimentary rocks from 17 sites from 34E to 40E along SWIR. We also sampled peridotites from the Rodriguez Triple Junction (RTJ) where three ridge system, the Central Indian Ridge, the Southeast Indian Ridge and SWIR meet together (YK05-16 Leg1 at 2005 by R/V Yokosuka and Shinkai 6500).

The Re-Os isotope systematics were investigated to identify the source of basalts and peridotites. One of the major advantages using Re-Os system is that they are relatively robust to secondary effects, e.g. sea water alteration and mantle metasomatism. The Os isotope ratios of peridotites from SWIR and from RTJ are $^{187}Os/^{188}Os$ = 0.1239-0.1307, which are in the range of those reported as abyssal peridotites. The Os isotope ratios of spinels from SWIR, however, indicate more depleted signature; around $^{187}Os/^{188}Os$ = 0.121, compared to the primitive upper mantle ($^{187}Os/^{188}Os$ = 0.1296, [1]) and peridotites from SWIR of this study and [2]. Such mismatches of Os isotope ratios between the spinels and the peridotites have been also reported even within a hand specimen level [2]. The time of Rhenium depletion (T_{RD}) ages were estimated as around 1Ga for these spinels, which show that the host peridotites of spinels experienced melt extraction at least around 1Ga even they were recovered from the currently active ridge.

[1] Meisel *et al.* (2001) *GCA* **65**, 1311–1323. [2] Standish *et al.* (2001) *Geochem, Geophys. Geosyst.* **3**, 2001GC000161