Breakout session #1, Disturbance and recovery

• There are two different issues that disturbance recovery information will serve: (1) impacts on the carbon cycle, and (2) information for management (e.g., fire susceptibility modeling, illegal deforestation and logging, post-disturbance salvage logging, pest/pathogen invasion control).

• Disturbance puts greater demands on spatial sampling (global coverage to map it; high enough frequency to detect it and attribute it to a given year/season/month – and to help establish what is actually driving the event?). Recovery puts greater demands on accuracy/precision—the location is defined by disturbance, but the process is relatively slow so we need to detect relatively small changes. These relatively subtle increases in biomass post-disturbance are also relevant to other "chronic disturbances" such as N-deposition, C-fertilization, etc.

• For disturbance, repeat sampling by lidar (after a global sample is achieved, and with stringent geospatial accuracy) would be useful for estimating/characterizing the disturbance impacts at a fine spatial resolution both horizontally and vertically. However, given the spot lidar sampling within a Radar grid, is the sampling intensity high enough to capture the probability distribution functions needed to describe and model disturbance/recovery processes? For example, is the gap size distribution of the lidar shots the same as the entire Radar pixel?

• Need a global baseline structure map in year 1 (wall-to-wall radar plus global sampling, with lidar, plus well-tested algorithms for data fusion). Need second global structure map in year 5 to use difference to evaluate standard chronosequence space-for-time substitution recovery trajectories. Would also like to have annual maps, with seasonal sampling repeated (e.g., peak biomass each year).

• Instrument should be able to measure heterogeneity of post-disturbance landscape—crown/canopy remaining, standing live, standing dead, felled dead (CWD), gap size distribution – e.g spatial clumping of tree mortality events and the associated probability distribution function.

• Disturbance classified as <u>abrupt</u> (fire, blowdown, land conversion, [selective] logging), <u>slow/chronic</u> (disease, insects, pollution, drought), chronic (insect, drought, N-deposition, C-fertilization – **note for breakout**: can "disturbance" can be classified as both positive and negative changes?), and <u>background</u> (1-5% annual mortality events that occur every year regardless of abrupt/chronic disturbance – would the Lidar "subsamples" see this?).

• There is a need for prototype studies of disturbance measurements with radar/lidar fusion instruments (airborne or other existing) to better quantify the instrument requirements (e.g., Katrina, fire chronosequences, etc.). These prototype studies should be initiated immediately to allow results to inform sensor and platform development.

• Spatial scales: radar - 100 m resolution but with an accuracy to detect ~20 m (400 m^2) major disturbance events; lidar – less than 25 m.

• Investment in high spatial resolution data (e.g., optical at ~1 m) buys for selected disturbance areas would provided added value to radar/lidar data.

• Lidar "crossovers" important for quantifying changes to the same spatially located stand of trees – similar to tagged trees in a forest inventory. In contrast, lack of "crossovers" (i.e. new lidar shots at different locations within the same radar pixel) similar to revisiting a plot after a number of years without tagged trees to quantify average changes. The benefits of each can be related to decades of forest inventory plot sampling using tagged and non-tagged trees (e.g Clark et al. 2001 NPP methods paper).

• An ability to quantify small annual changes over the life of the sensor would allow testing of some key hypothesis on forest change – e.g. C-fertilization, N-deposition relationships with forest productivity, and other subtle but important shifts. Globally important signals here are on the order of 1-2 Mg C ha^{-1} yr^{-1}, or 5-10 Mg C ha^{-1} yr^{-1} over a five-year mission. A five-year mission would be much more valuable than a three-year mission.

• Wood encroachment (e.g. the expansion of woody shrub vegetation into grasslands) is an important process in the global C-cycle, and the terrestrial mission should not be focused on only forest and trees but all woody vegetation.

• Pilot studies would also allow the community to more fully develop the exciting new science questions that could be addressed with a radar/lidar fusion.