Autonomous Instrumentation for CO_2 Measurements on Remote Coastal Towers

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The North American Carbon Plan (NACP) specifies several priorities including: 1) monitoring atmospheric CO_2 and other trace gases crossing the land/coastal boundary and 2) understanding energetic coastal processes that influence atmospheric carbon dioxide in the marine atmospheric boundary layer. In Figure 1 we show preliminary data from a prototype tower-based ocean and atmospheric CO_2 observing system located 3 miles off the coast of Martha's Vineyard, Massachusetts on Martha's Vineyard Coastal Observatory (MVCO). In the future, this ocean tower system will not only measure atmospheric CO_2 traceable to WMO primary standards, but also will directly measure air-sea fluxes of CO_2 using high flow eddy covariance techniques. To perform these tasks the system was designed and constructed to meet the following criteria: 1) low power consumption (60 W); 2) high accuracy (0.1 ppm); 3) thermal stability (dT/dt <0.1 C/hr); 4) ability to maintain the water vapor concentration difference between sample and standards to levels that are undetectable to CO_2 measurements (<180 ppm water vapor) and 5) ability to operate remotely for long periods (> 6 months).

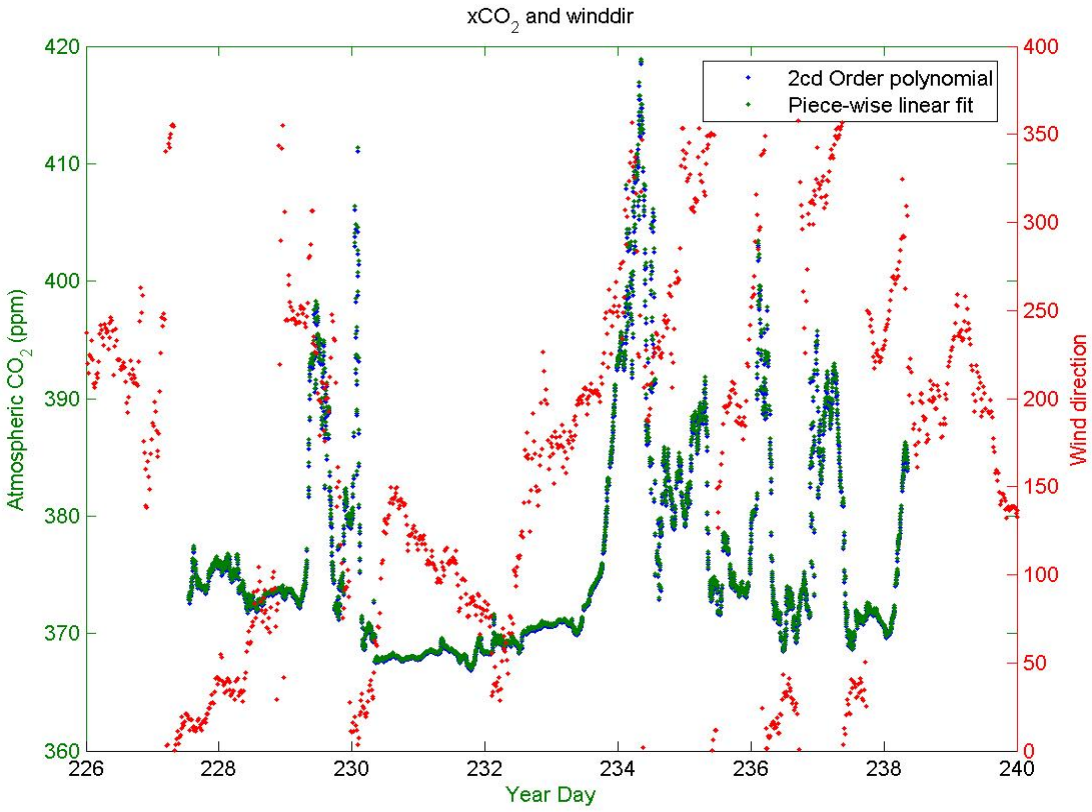

Figure 1. Seventeen day segment of data collected between October 7 and 24, 2005 indicate a strong correlation between wind direction and atmospheric CO_2 concentration. While southeasterly breezes bring in low and steady concentrations of CO_2 from offshore, point sources from land to the west bring in extremely high and variable concentrations of CO_2 indicating air masses traveling more than 100 km are not well mixed.