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More than "just" CO_2: Multiple trace gas exchange measurements at a temperate mountain grassland

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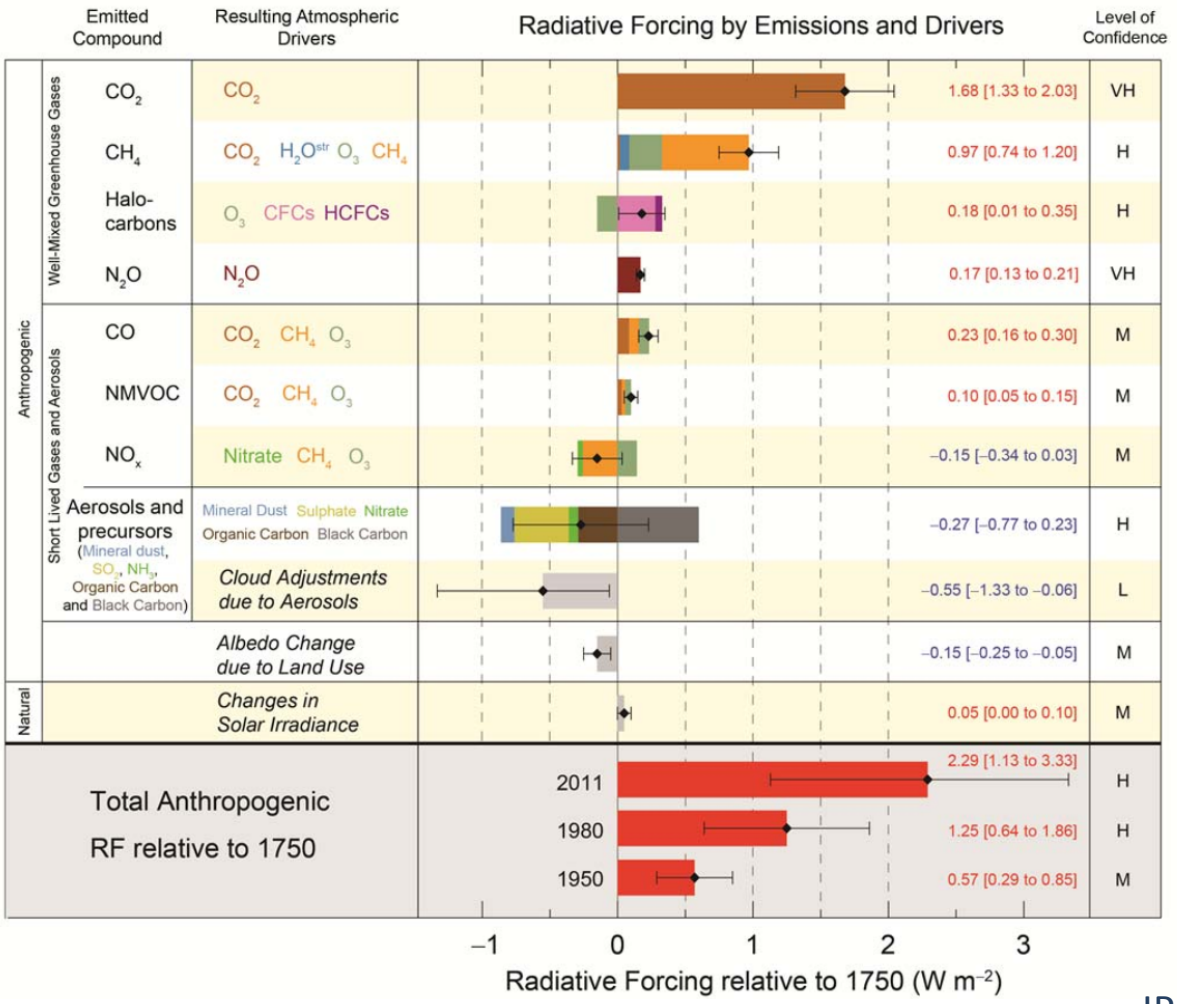
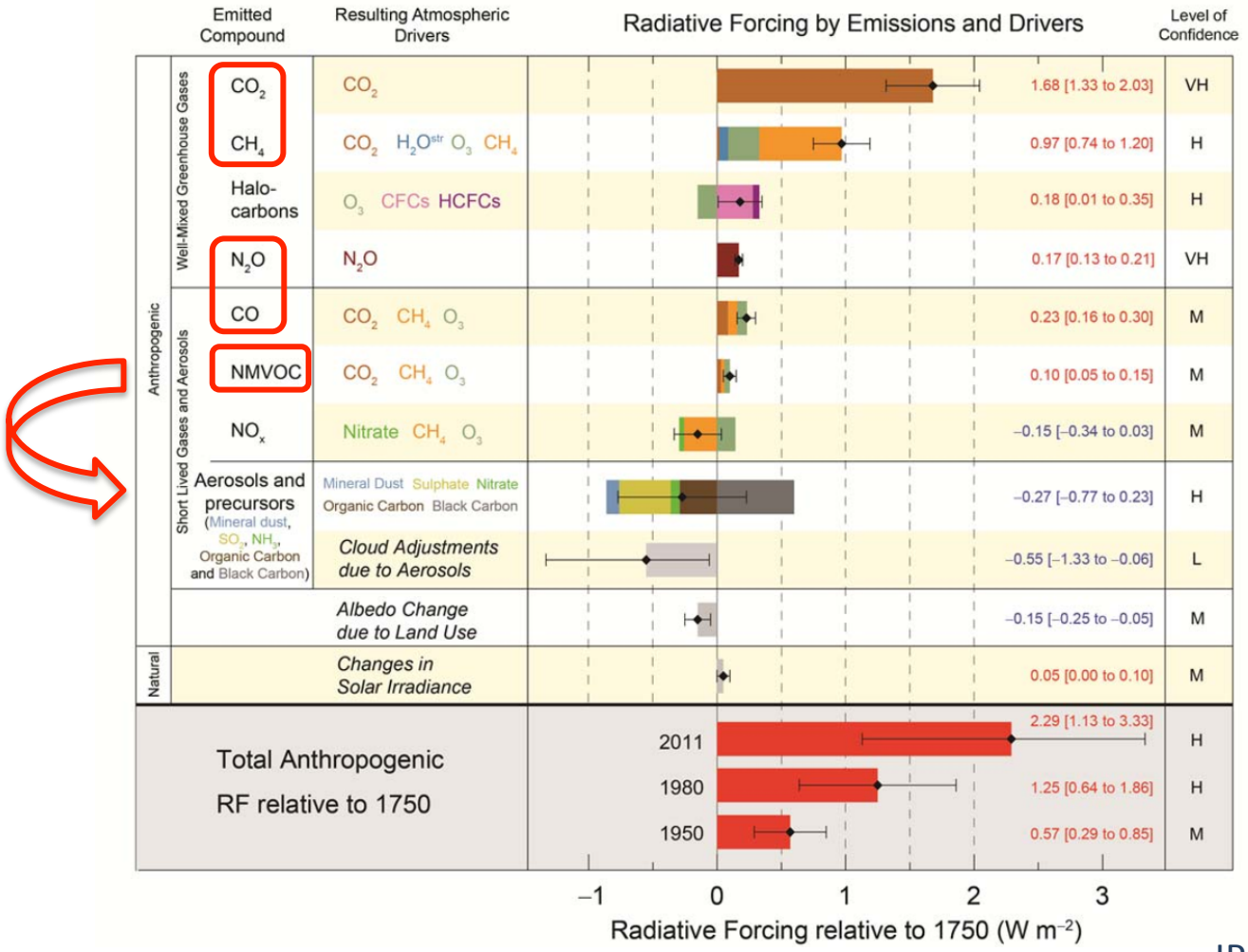
Motivation



IPCC AR5 WG1 (2013)

Motivation



IPCC AR5 WG1 (2013)



Study site Neustift

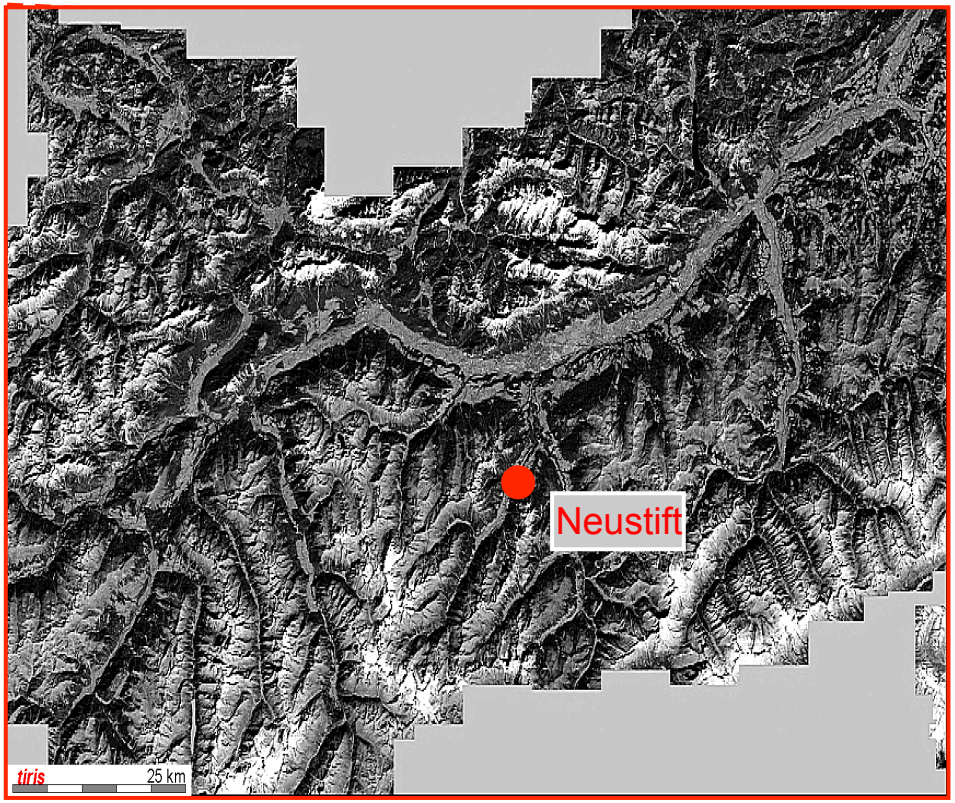
Mission statement

"… a field laboratory to quantify environmentally relevant interactions between a managed temperate mountain grassland and the atmosphere on a long-term basis …"

Study site Neustift



Study site Neustift



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Study site Neustift

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Research lines

Basic abiotic and biotic drivers

Latent and sensible heat and momentum fluxes

N_2O fluxes

CH_4 fluxes

CO_2 fluxes

GHG

Carbon budget

VOC fluxes

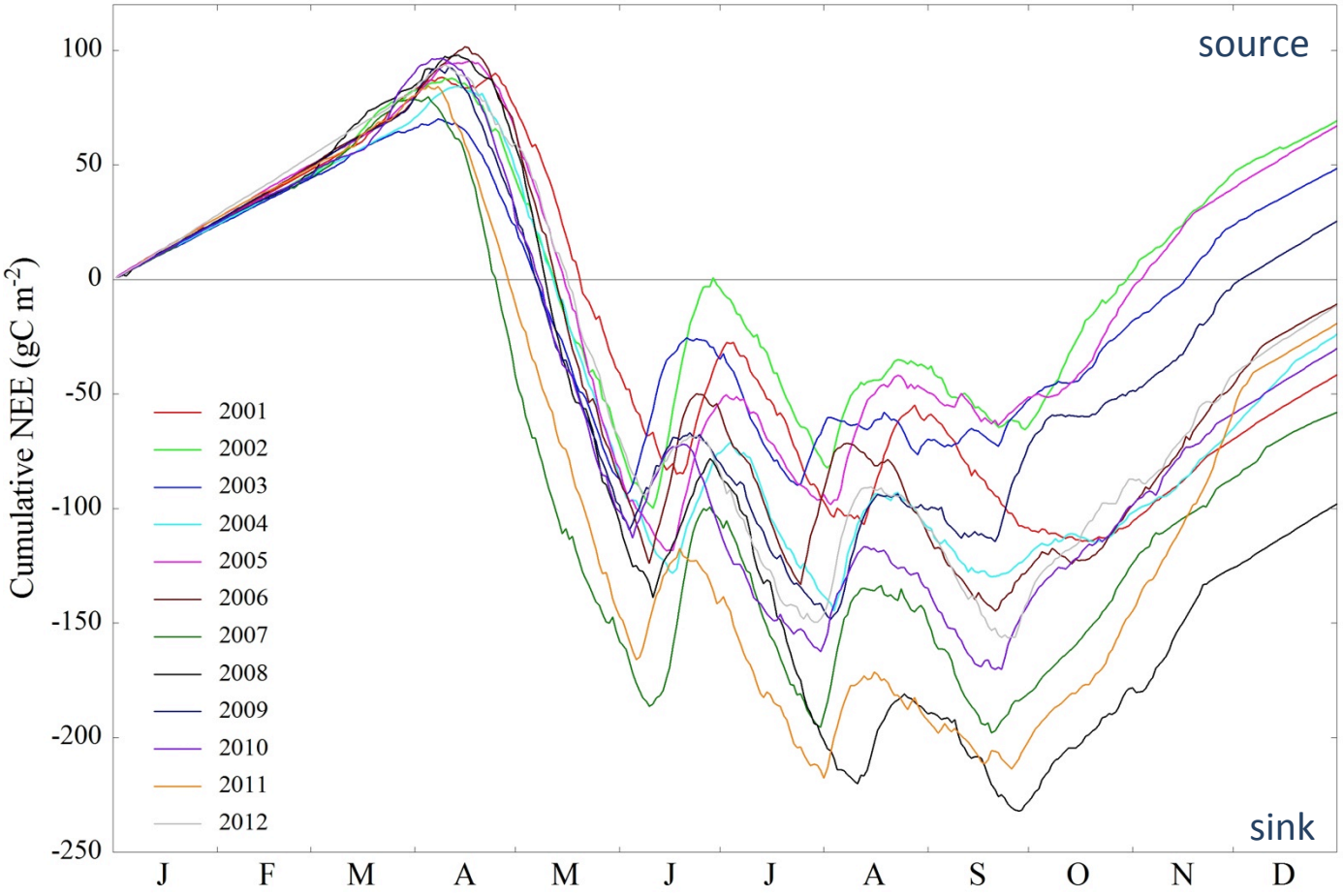
VOC fluxes

CO fluxes

O_3 fluxes

Air quality

CO_2 exchange



Max: +69 gC m^{-2}

Avg: -7 gC m^{-2}

Stdv: ±50 gC m^{-2}

Min: -97 gC m^{-2}

Wohlfahrt et al. (2008) & unpublished data (2007-2012)

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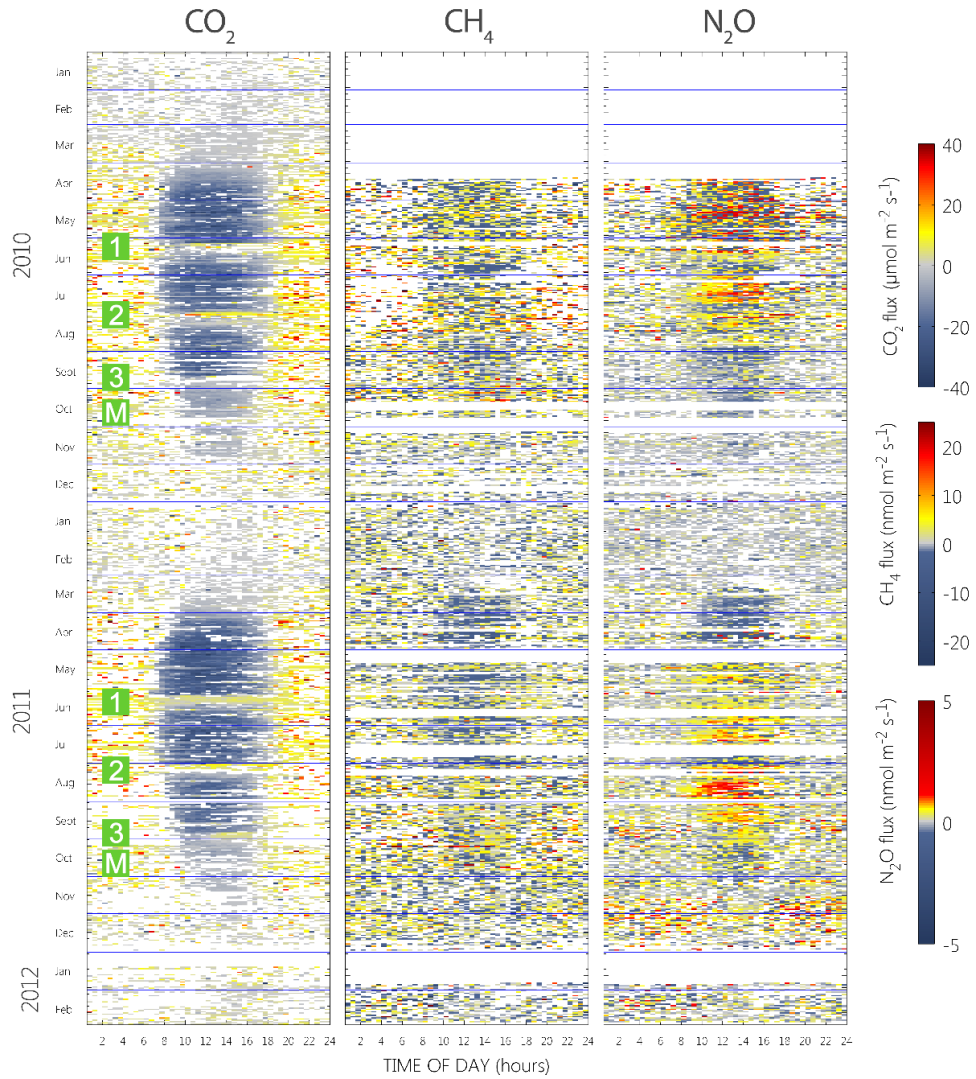
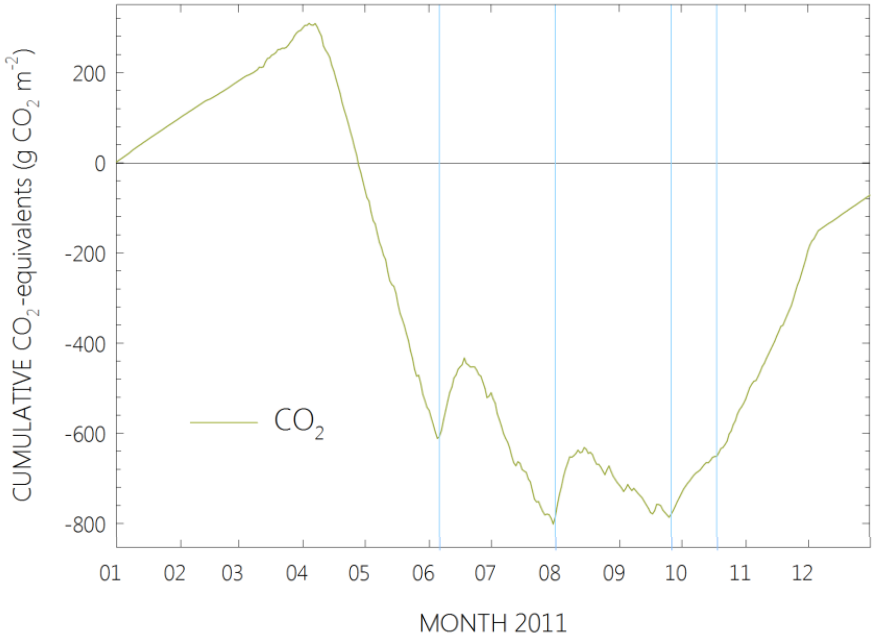
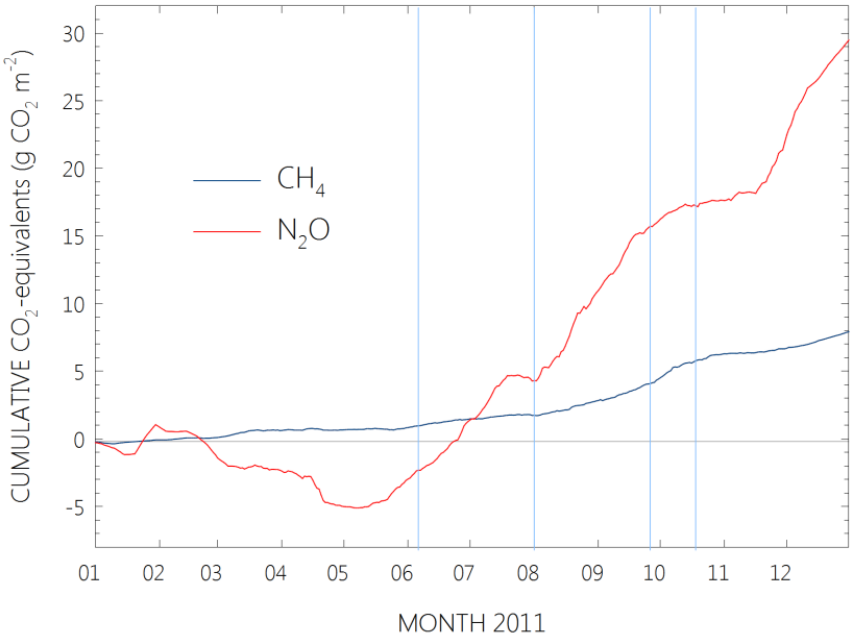
CH_4 and N_2O exchange



Hörtnagl & Wohlfahrt (2014)

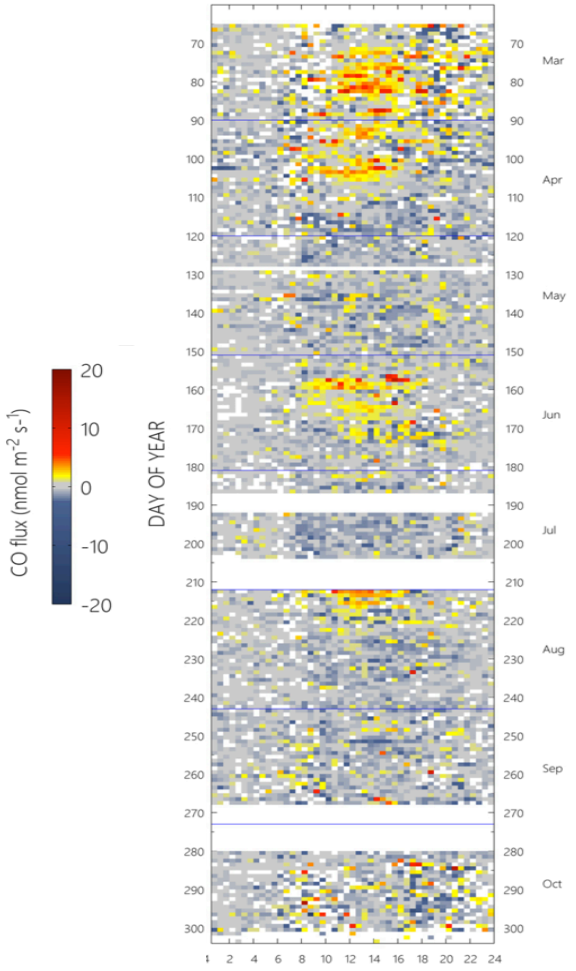
CO_2 equivalents

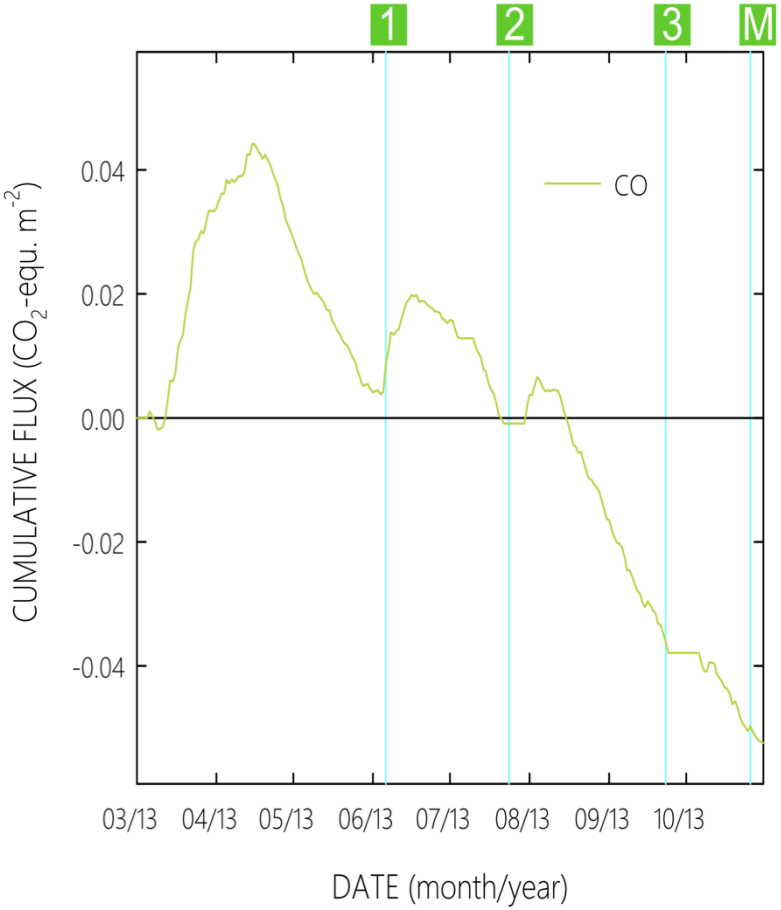




Hörtnagl & Wohlfahrt (2014)

CO exchange





Hörtnagl et al. (in prep.)

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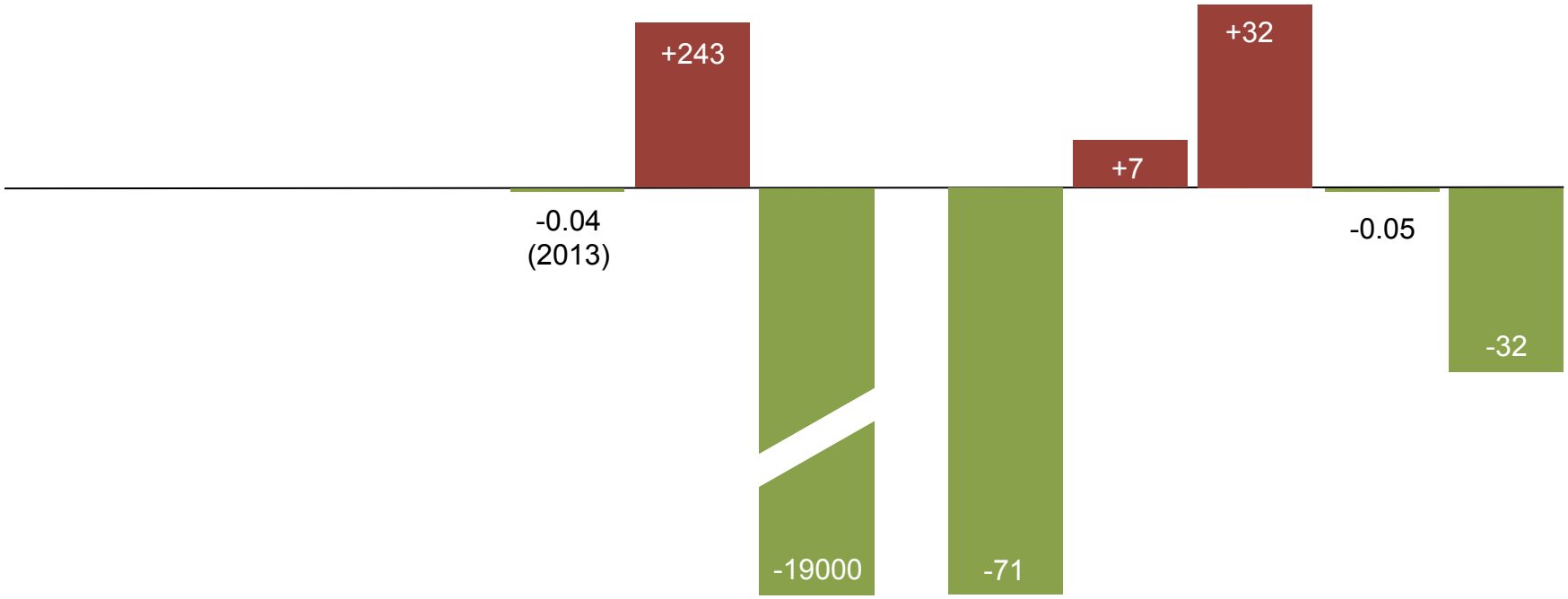
Summary #1

(2009 &) 2011 CUMULATIVE CARBON (mg C m^{-2})

CH_4O	C_2H_4O	C_3H_6O	$C_{10}H_{16}$	CO	CH_4	CO_2

2011 GHG TOTAL (g CO_2-equivalents m^{-2})

CO_2	CH_4	N_2O	CO	TOTAL



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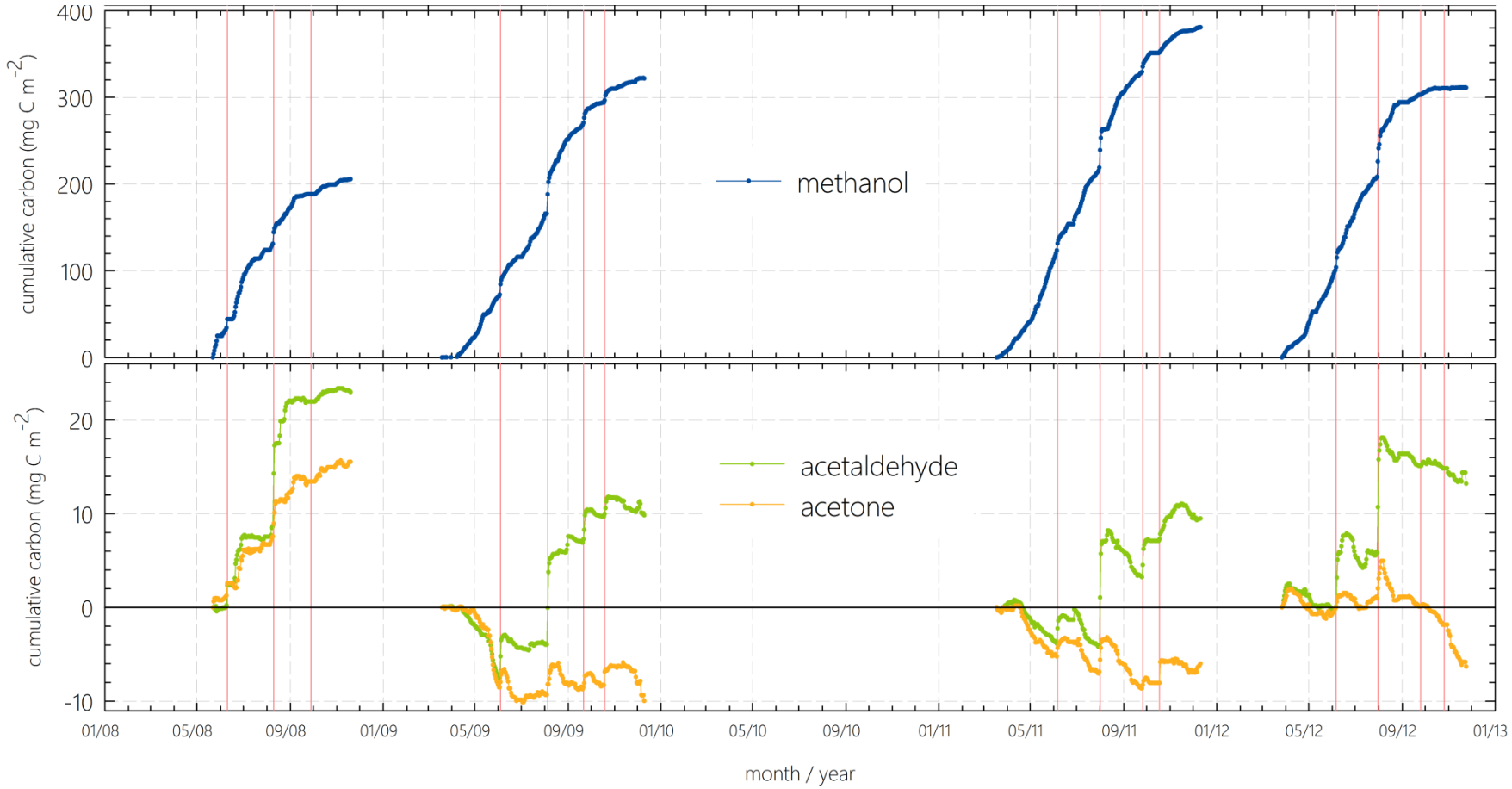
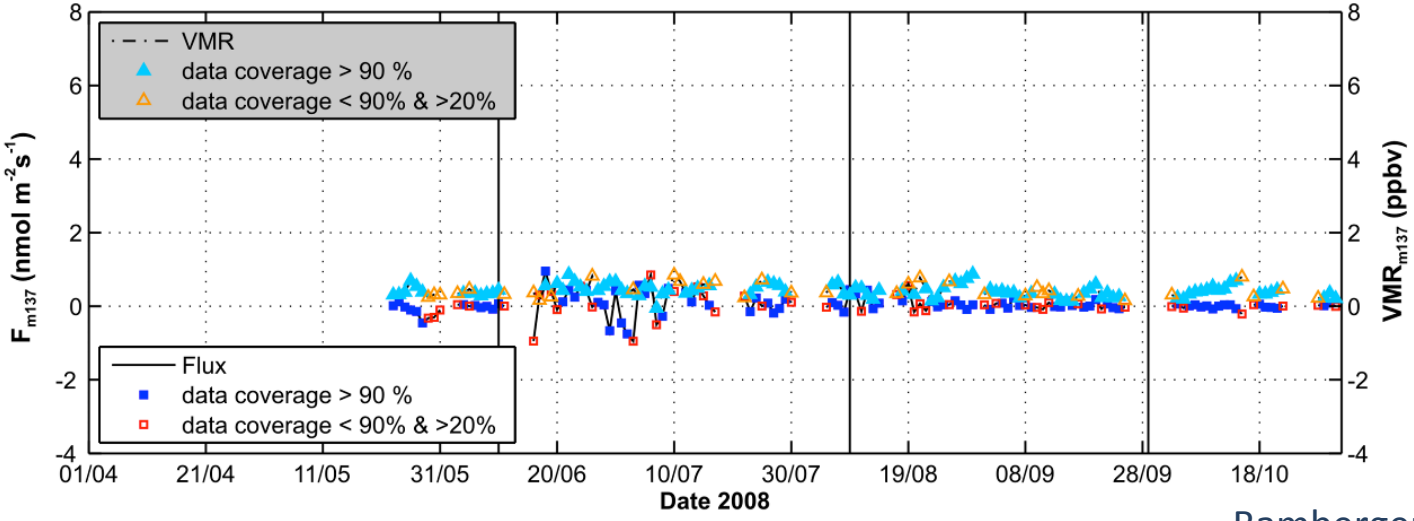
Oxygenated VOC exchange



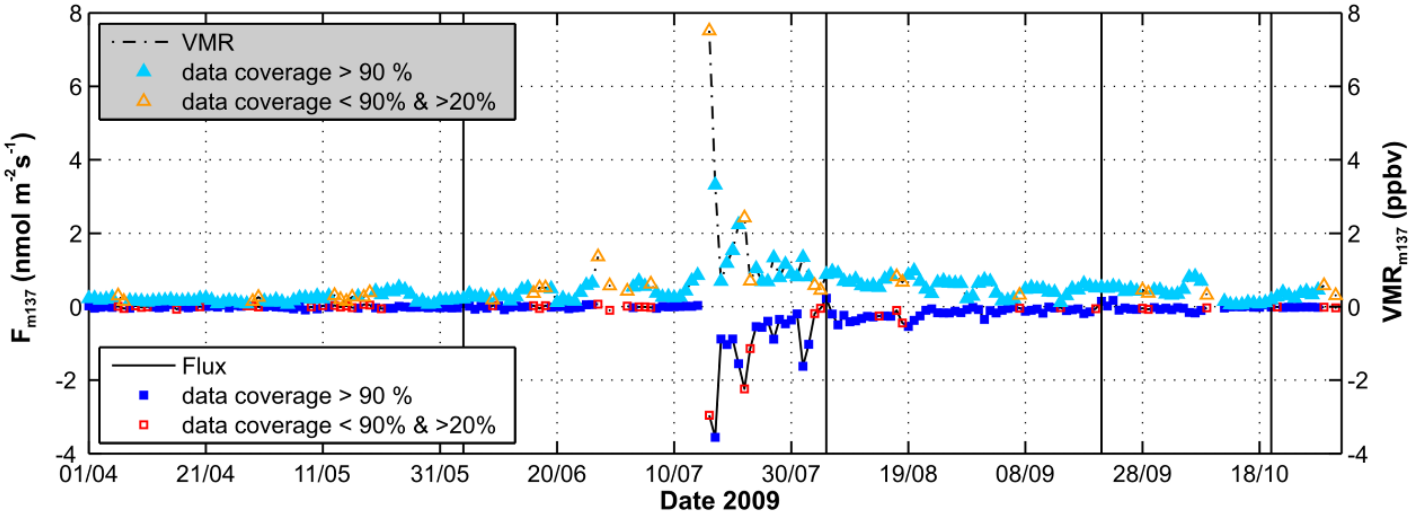
Hörtnagl et al. (2014), Wohlfahrt et al. (in prep.)

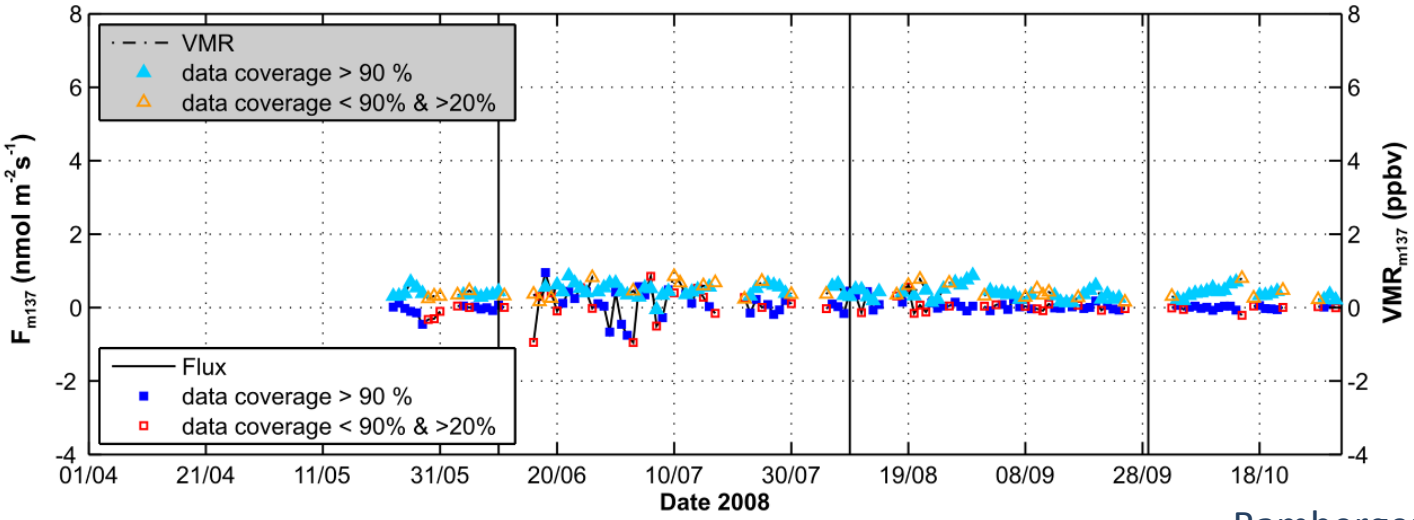
Monoterpene exchange



Bamberger et al. (2011)

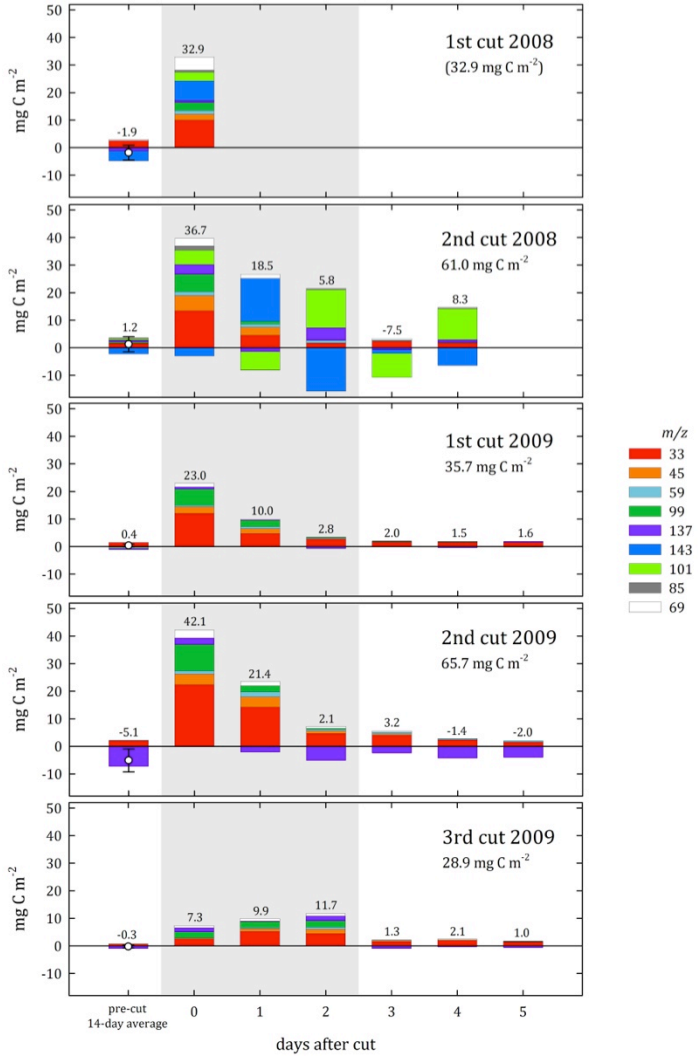
Monoterpene exchange





Bamberger et al. (2011)

VOC exchange after harvest



Brilli et al. (2012)

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Summary #2

(2009 &) 2011 CUMULATIVE CARBON (mg C m^{-2})

CH_4O	C_2H_4O	C_3H_6O	$C_{10}H_{16}$	CO	CH_4	CO_2
+450 (+382)	? (+6)	? (-12)	+3 (-327)	-0.04 (2013)	+243	-19000

2011 GHG TOTAL (g CO_2-equivalents m^{-2})

CO_2	CH_4	N_2O	CO	TOTAL
-71	+7	+32	-0.05	-32

Conclusions

- In terms of GWP, emissions of CH_4 and N_2O negate about 50% of net CO_2 uptake (at least in 2011).
- For the carbon balance, CO_2 is quantitatively by far the most significant gaseous component flux. Sum of VOC exceeds CH_4 fluxes.
- VOC exchange of importance for regional air quality and indirect radiative forcing.
- Many compounds exhibit both net emission and deposition, driven by temporal changes in abiotic and biotic forcings.
- Harvesting dates represent “hot moments” at this managed ecosystem with composition and magnitude of ecosystem-atmosphere transfer changing dramatically.

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Acknowledgments

FWF Der Wissenschaftsfonds.

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tirol STADT INNSBRUCK

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EU FP 5 CarboMont (2001-2004)
EU FP 7 GHG-Europe (2010-2013)

ÖAW Austrian Academy of Sciences

ÖAW DOC fellowship to
Albin Hammerle (2007-2009)

Sparkling Science
Wissenschaft ruft Schule
Schule ruft Wissenschaft
BMWF

GrassClim (2010-2012)

Doctorate/PostDoc fellowships to
Albin Hammerle (2009-2010)
Lukas Hörtnagl (2009-2010)



Net ecosystem carbon balance


NECB ≈27

NEE
7

F_{CH4}
-0.2

F_{VOC}
-0.5

GPP
1657

ER
-1650

C_{export}
-318

C_{ag}
248

C_{bg}
569

C_{import}
369

SOM
8087

Kindler et al. (2011)

$F_{DIC/DOC}$
-30

Units: pools (gC m^{-2}) and fluxes (gC m^{-2} y^{-1})