Assessment of Climate Change for the Baltic Sea Basin - The BACC Project - 22-23 May 2006, Göteborg, Sweden

Climate-related Change in Terrestrial Ecosystems

1) Recent and Historical Changes

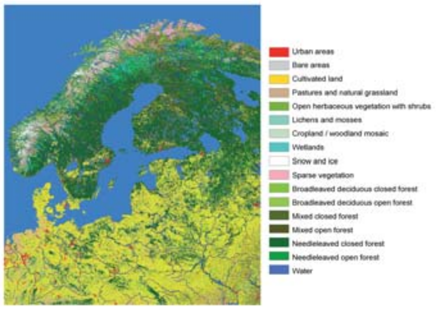

Fig. 1: Land cover in the Baltic Sea catchment area. Adapted from Ledwith (2003), GLC2000 project.

Fig. 3: Cultivated landscape, Poland. Photo: Ben Smith.

Fig. 4: Mean rate of change (days per year) in date of leaf unfolding in birch (Betula pendula) from the southern and eastern Baltic coasts over the period 1951-1998. Source: Ahas et al. 2002.

Table 1. Changes in phenological time series (days per year) for 1951-1998 at selected observation sites presented in Figure 1. (*P<0.05; F = flowering, L = leaf unfolding, D = defoliation). Source: Ahas et al. 2002.

Station	Corylus F	Tussilago F	Taraxacum F	Betula L	Malus F	Syringa F	Sorbus F	Tilia F	Betula D
Benz	-0.90	0.01	-0.08	-0.37*	-0.15	-0.14			
Bobrowniki	-0.36	-0.11	-0.27*	-0.14		-0.05			
Borok		-0.45*		-0.17	-0.06	-0.08	-0.13	-0.18	0.31
Dobele	-0.36			-0.21*	-0.25*	-0.16	-0.23*		-0.02
Göttingen	0.06	0.20	-0.30	-0.26*	-0.17	0.01		0.24	
Kronach	-0.32	-0.25	-0.22	-0.34*	-0.11	-0.02		-0.09	
Nereta	-0.91*	0.10	0.05	-0.15	-0.11	-0.12	-0.17		0.15
Niedzwiedz	-0.11	-0.18	-0.20	0.14		-0.13			
Pärnu	-0.46*			-0.33*	-0.18*	-0.26*	-0.27*	-0.20	
Schleswig	-0.40	-0.20	-0.09	-0.06	-0.09	-0.13		0.05	
Starzyce	-0.29	-0.16	-0.45*	-0.23		0.18			
Wegorzewo	-0.40	-0.17	-0.16	-0.26*		-0.15			
Võru	-0.18			-0.21*	-0.24*	-0.23*	-0.23*	-0.09	
Volkovysk			-0.10	-0.07	-0.03	-0.05	-0.09	-0.09	

The catchment area of the Baltic Sea spans some 20 degrees of latitude and climate types ranging from cool temperate through boreal to alpine and subarctic. The southeastern temperate area is characterized by a cultivated landscape, the northern, boreal part by coniferous forests and peatlands (Fig. 1-3). Most of the forests are managed stands of native tree species. Cold-climate shrublands and tundra occur in mountainous areas and in the subarctic far north. Wetlands are a significant feature of the boreal and subarctic zones.

Climate changes in recent decades include increasing temperatures and changing precipitation patterns. In addition, changes in non-climatic factors such as atmospheric CO_2 concentrations, deposition rates of atmospheric pollutants, land use and forest management have affected the structure and functioning of terrestrial ecosystems in the Baltic Sea region. Impacts potentially attributable to these changes include the following.

Phenology shifts - Changing seasonal patterns in vegetation

- Advancement of spring and summer phases by 5-20 days over the last 50 years in many plant species (Fig. 4, Table 1)
- Delay of autumn phases by 5-30 days over the last 50 years in some plant species (Table 1)
- Growing season extended by ca. 20 days over the last 50 years in many plant species

Species and biome distributions

- Cold-limit range boundary shifts tracking isotherm migration for some plant and animal species
- Reduced migratory distances, changed migratory direction, increasing proportion of non-migrating individuals in some birds and other migratory species
- Treeline advance, mainly due to increased height growth in extant individuals, in the Fennoscandian mountains (Fig. 5)

Changed Ecosystem Biogeochemistry

- Increased greenness visible from space reflects enhanced vegetation growth and an extended growing season (Fig. 6)
- Land areas of the Baltic Sea basin are currently a net sink for CO_2 from the atmosphere; causes include climatically-induced growth increases (Fig. 6), longer rotation times in forest, and conversion of farmland to forestry
- Permafrost melting may be causing a shift towards a greater proportional coverage of wet habitats in tundra; possible consequences include increased methane release and accentuated greenhouse forcing

Increased Stress due to Changing Conditions

- Physiological stress related to combined effects of atmospheric pollutants and extreme weather events such as frosts and droughts may be a contributing explanation for late 20th century dieback in boreal and temperate forests.

Fig. 2: Boreal conifer forest, Finland. Photo: Ben Smith

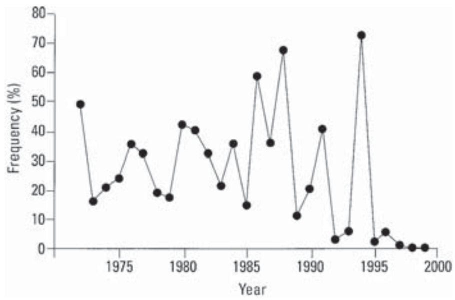

Fig. 5: Annual frequency of tree-limit pine saplings with more than 20% of the available foliage killed by winter dessication, Handölan valley, Sweden. The degree of dieback has been uniquely low since 1995, reflecting increasingly mild winters. Source: Kullman (2001).

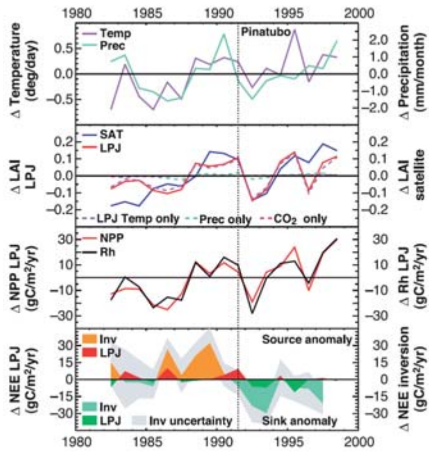

Fig. 6: Changes in climate, vegetation activity and ecosystem biogeochemistry for the northern hemisphere boreal zone 1982-1998. A trend of increasing leaf area index (LAI) according to satellite observations is reproduced by an ecosystem model (LPJ) based on climate data alone. Potential consequences for net primary production (NPP), heterotrophic respiration (Rh) and net ecosystem carbon exchange (NEE, i.e. the balance of NPP and Rh) are described by the model and compared with estimates based on inversion of atmospheric CO_2 measurements. The vegetation greening trend for the Baltic Sea basin is representative for the northern high latitudes as a whole. Source: Lucht et al. (2002).

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