IPCC AR5 Arctic

Methane emissions could increase dramatically this century
'Methane emissions, from Arctic thawing permafrost and subsea floor methane hydrates in the Arctic, could increase dramatically due to the rapid climate warming of the Arctic and these large carbon pools stored there.' (AR5 WG1 FAQ 6.1)

Arctic amplifying feedback runaway risk
'Should a sizeable fraction of this Arctic frozen carbon be released as methane and CO2, it would increase atmospheric concentrations, which would lead to higher atmospheric temperatures. That in turn would cause yet more methane and CO2 to be released, creating a positive feedback, which would further amplify global warming.' (AR5 WG1 FAQ 6.1)

Arctic summer sea ice – an amplifying feedback
Year-round reductions in Arctic sea ice are projected for all RCP scenarios. (AR5 Synthesis SPM p. 12)

Multiple large sources of amplifying feedback
'There is very high confidence that the Arctic region will warm most rapidly'. (AR5 WG1 SPM)

'Examples that could lead to substantial impact on climate [i.e., amplifying carbon feedback] are the boreal-tundra Arctic system and the Amazon forest. Carbon stored in the terrestrial biosphere (e.g., in peatlands, permafrost, and forests) is susceptible to loss to the atmosphere [i.e amplifying carbon feedback] as a result of climate change, deforestation, and ecosystem degradation (high confidence). Increased tree mortality and associated forest dieback is projected to occur in many regions over the 21st century, due to increased temperatures and drought. Forest dieback poses risks for carbon storage and biodiversity.' (AR5 WG2 SPM p. 15)

Thawing permafrost could add another 1.5°C of global warming by 2100
'Until the year 2100, up to 250 PgC [picograms of carbon] could be released as CO2, and up to 5 Pg as CH4. Given methane's stronger greenhouse warming potential, that corresponds to a further 100 PgC of equivalent CO2 released until the year 2100 [so 350PgC and about 1.5°C].' (AR5 WG1 FAQ 6.1)

'Carbon stored in the terrestrial biosphere is susceptible to loss to the atmosphere as a result of climate change, deforestation, and ecosystem degradation (high confidence). The aspects of climate change with direct effects on stored terrestrial carbon include high temperatures, drought and windstorms; indirect effects include increased risk of fires, pest and disease outbreaks. Increased tree mortality and associated forest dieback is projected to occur in many regions over the 21st century (medium confidence), posing risks for carbon storage, biodiversity, wood production, water quality, amenity, and economic activity. There is a high risk of substantial carbon and methane emissions as a result of permafrost thawing.' (AR5 SYN Long-27)

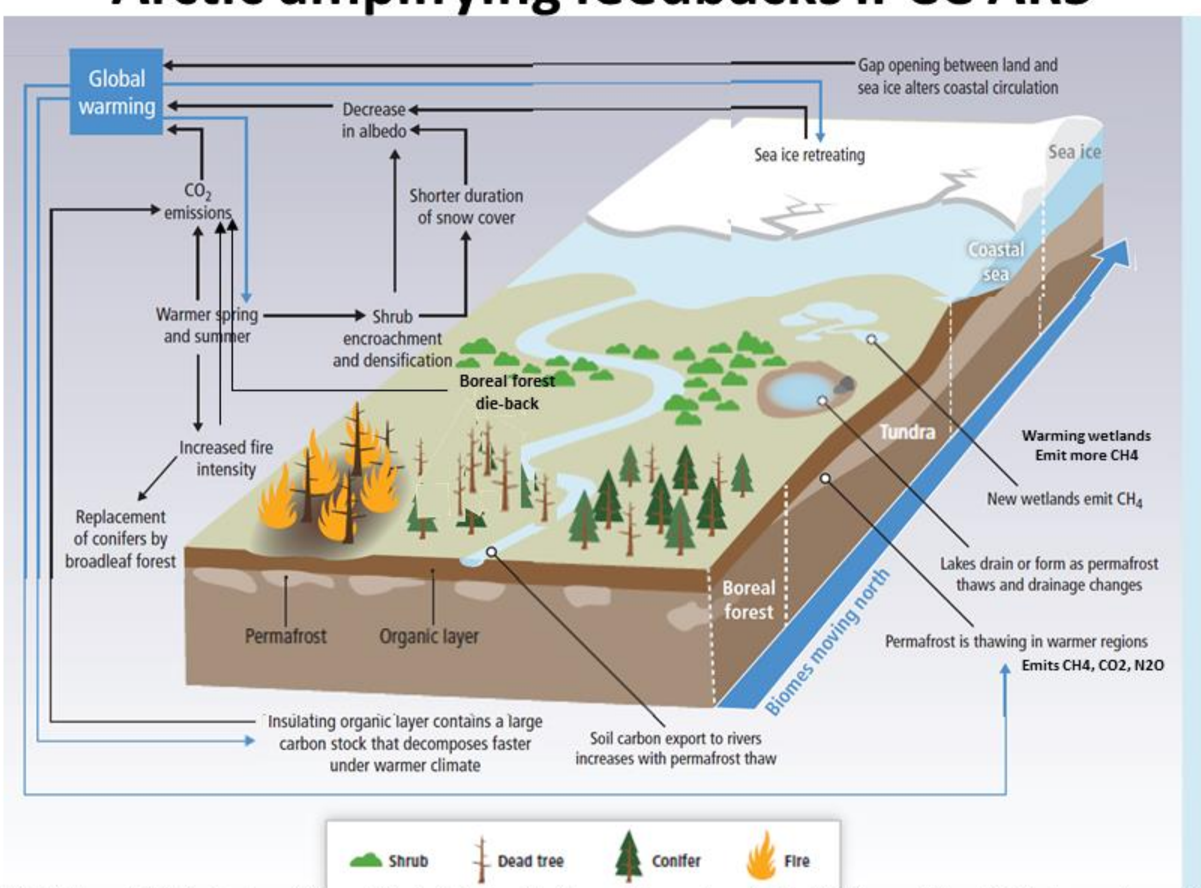
IPCC AR5 WG2
4.3.3.4. Tundra, Alpine, and Permafrost Systems

Frozen soils and permafrost currently hold about 1700 PgC, more than twice the carbon than the atmosphere, and thus represent a particularly large vulnerability to climate change (i.e., warming)

Although the Arctic is currently a net carbon sink, continued warming will act to turn the Arctic to a net carbon source, which will in turn create a potentially strong positive feedback to accelerate Arctic (and global) warming with additional releases of CO2, CH4, and perhaps N2O, from the terrestrial biosphere into the atmosphere (high confidence; Schuur et al., 2008, 2009; Maslin et al., 2010; McGuire et al., 2010; O'Connor et al., 2010; Schaefer et al., 2011.)

Moreover, this feedback is already accelerating due to climate-induced increases in fire (McGuire et al., 2010; O'Donnell et al., 2011). The rapid retreat of snow cover and resulting spread of shrubs and trees into areas currently dominated by tundra has begun, and will continue to serve as a positive feedback accelerating high-latitude warming (Chapin III et al., 2005; Bonfils et al., 2012).

Arctic amplifying feedbacks IPCC AR5



From IPCC AR5 WG2 Figure 4-10 | Tundra–boreal biome shift. Earth System Models predict a northward shift of Arctic vegetation with climate warming, as the boreal biome migrates into what is currently tundra. Observations of shrub expansion in tundra, increased tree growth at the tundra–forest transition, and tree mortality at the southern extent of the boreal forest in recent decades are consistent with model projections. Vegetation changes associated with a biome shift, which is facilitated by intensification of the fire regime, will modify surface energy budgets, and net ecosystem carbon balance, permafrost thawing, and methane emissions, with net feedbacks to additional climate change.