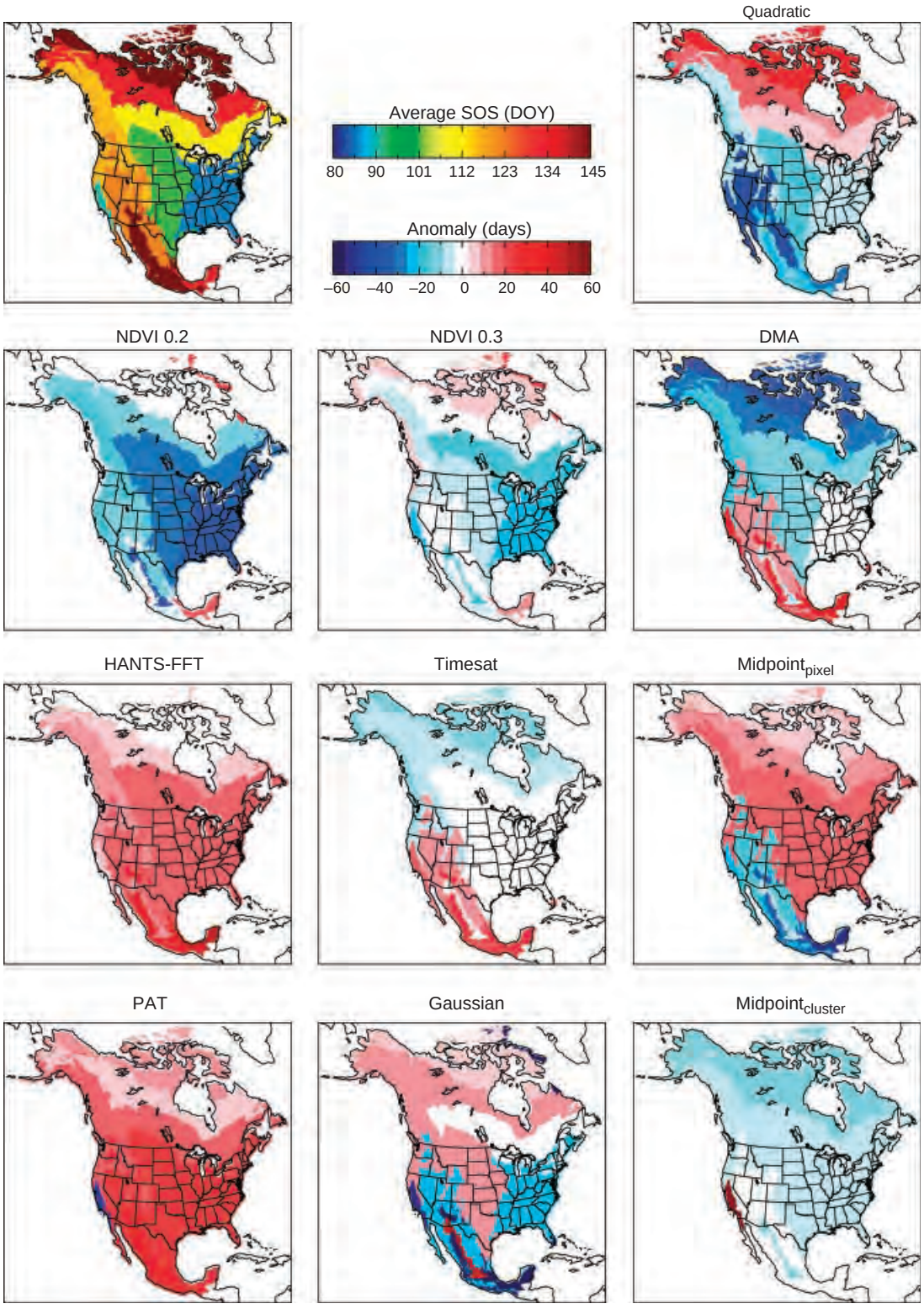

Fig. 2 Ensemble satellite derived SOS averaged by ecoregion and over the 1982 2006 record (upper left panel, ecoregions visible as color blocks). Remaining panels show the SOS anomaly between individual methods and the ensemble, thus indicating locations in which individual SOS methods are earlier or later than the ensemble.

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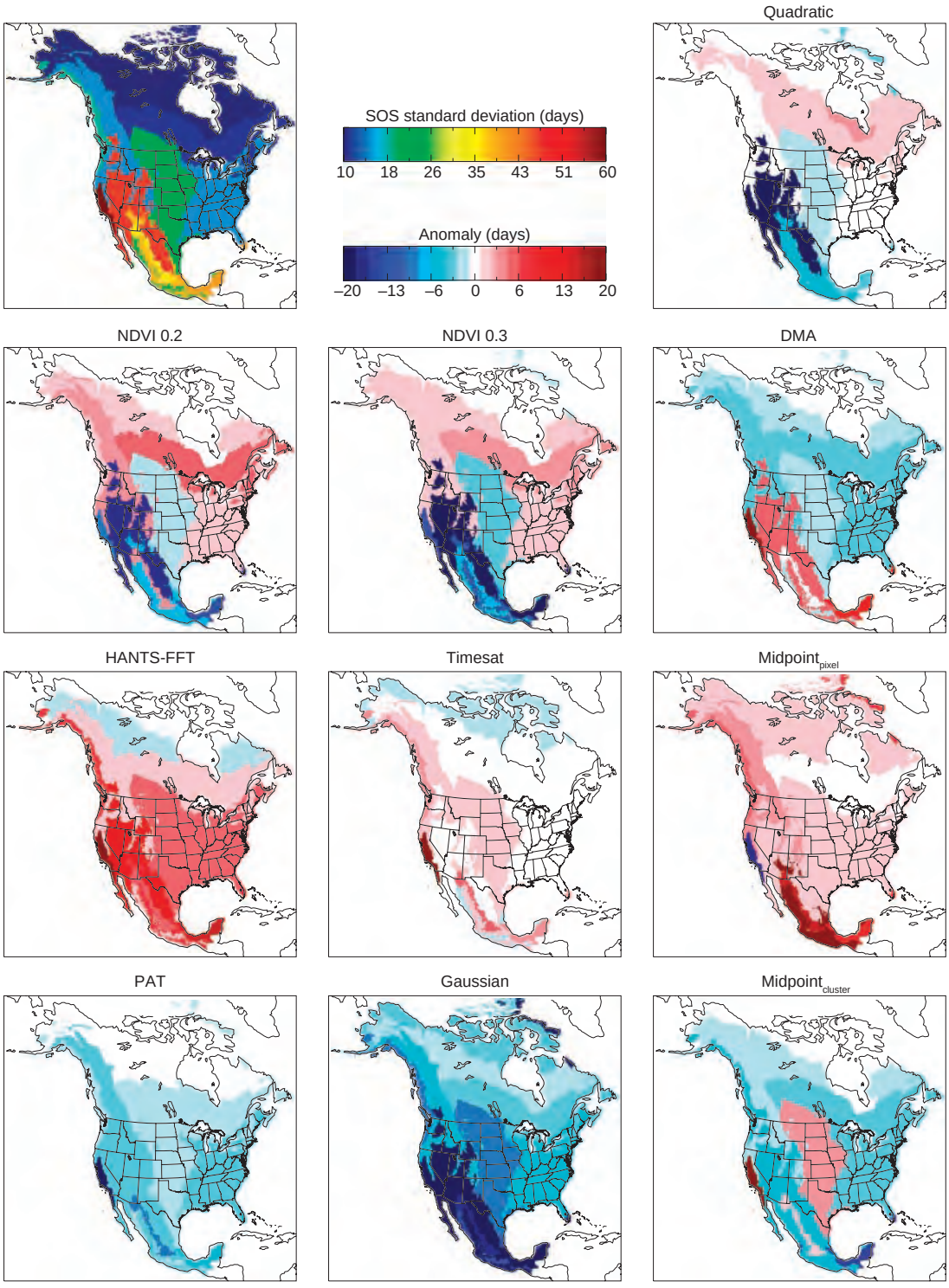

Fig. 3 Ensemble 1982 2006 SOS standard deviation (upper left panel, ecoregions visible as color blocks). Remaining panels show the SOS standard deviation anomaly between individual methods and the ensemble, thus indicating locations in which individual SOS methods were more or less variable than the ensemble.

SOS estimates were retrievable (where a retrieval refers to a successful estimation of SOS – failures occur due to method-specific treatment of missing data, screening, etc.) by all methods in all years only in the Hudson Plain ecoregion (Fig. 4). Retrievals averaged only 7 years in the Arctic Cordillera and were also low

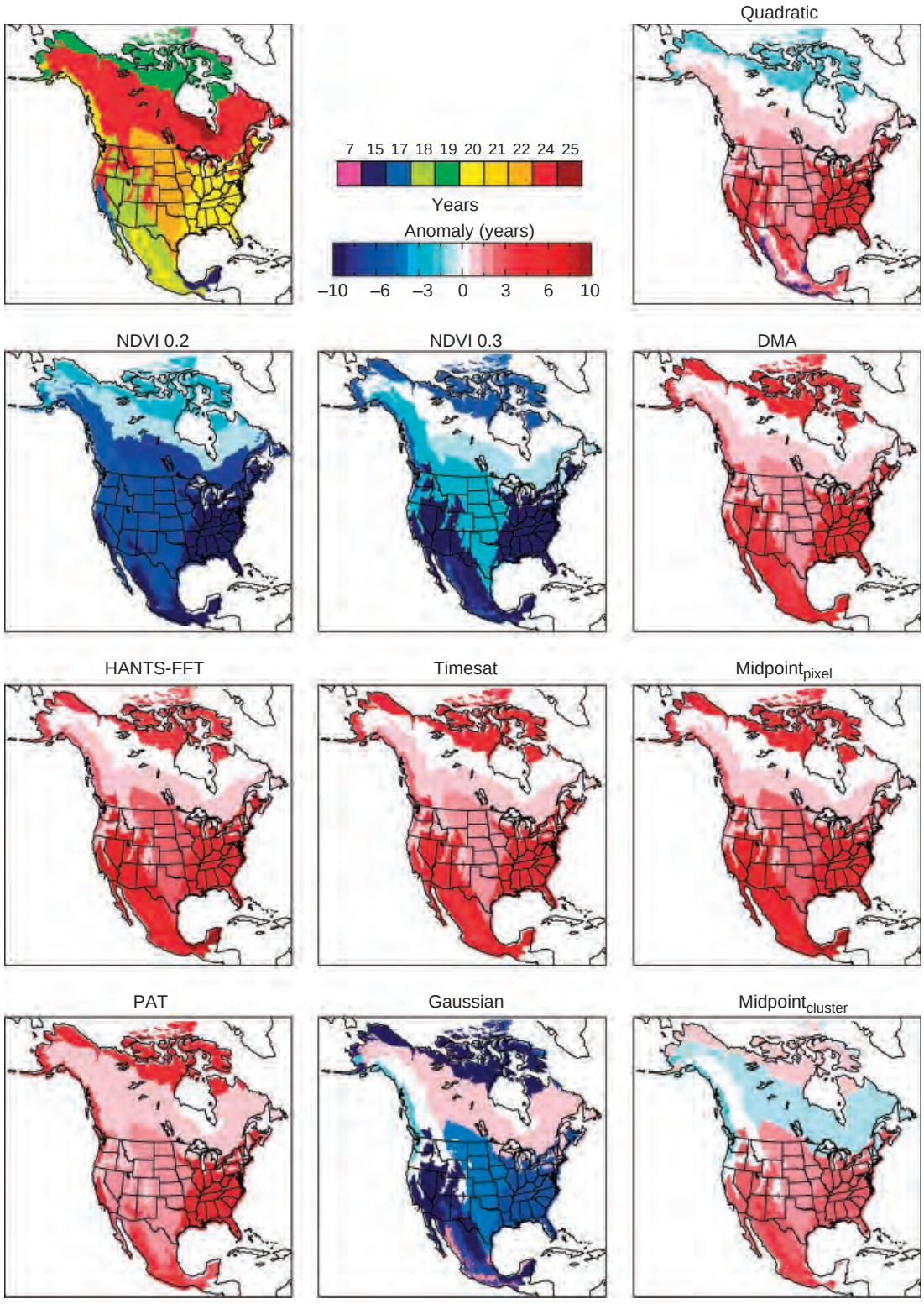

Fig. 4 Ensemble SOS retrieval rate (upper left panel, maximum of 25, ecoregions visible as color blocks). Low values indicate frequent failures to retrieve SOS estimates. Remaining panels show the retrieval rate anomaly between individual methods and the ensemble, thus indicating locations in which individual SOS methods were more or less able to retrieve SOS estimates.

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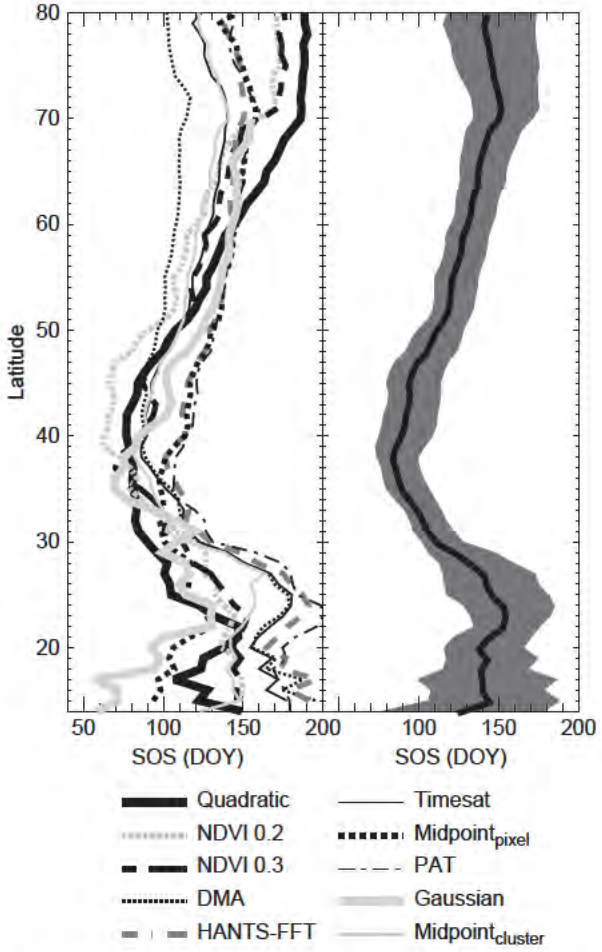

Fig. 5 Average start of spring (SOS) calculated by latitude (left panel) and shown as the ensemble mean and standard deviation (right panel).

in Tropical Wet Forests (15 years), Mediterranean California (17 years), and North American Deserts (18 years). Retrieval rates were highest in forested ecoregions with strong annual snow cycles. Among methods, DMA, HANTS-FFT, Timesat, Midpoint$_{pixel}$, PAT and Midpoint$_{cluster}$ were consistently better able to retrieve SOS estimates while all other methods had lower retrieval rates.

SOS methods varied in their ordinal ranking across latitude such that a method consistently early at high latitudes, such as DMA, could become a late method at low latitudes (Fig. 5). Of all the methods, only Timesat and Midpoint$_{cluster}$ tended to maintain approximately the same ordinal ranking. As an ensemble, the latitudinal average showed late SOS at both low and high latitudes and earliest SOS at about 40°. Variability was high above 70° and below 30° and extreme below 20°.

Assessment of annual time series and long-term behavior supports other findings of inconsistent SOS behavior among methods and ecoregion (Figs 6 and 7). The DMA was early and maximally stable in high latitude ecoregions but often late and dynamic in southern ecoregions (compare top and bottom rows of Figs 6 and 7). Among-method variability increased with both aridity (North American Deserts, Southern Semi-arid Highlands) and humidity (Tropical Wet Forests). Consistent with other results, within- and among-method variability was highest for Mediterranean California (Fig. 7).

SOS interpretation with cryospheric/hydrologic metrics

Correlations showed that cryospheric/hydrologic metrics were related to SOS retrievals but that the magnitude and location varied by ecoregion and SOS method (Table 3). Overall, comparisons of cryospheric dynamics were related to SOS while hydrologic dynamics were not. Of the five ecoregions with consistent annual snow cycles, only the Hudson Plain ecoregion had correlations with $P<0.05$ between the date of initial snowmelt and all SOS methods. Correlations were next highest in Northern Forests (mean of 0.49 across SOS methods). Among methods, PAT stood out as being minimally related to initial snow melt. SSM/I soil thaw comparisons were possible in nine ecoregions (Table 3). Here, correlations were high in two northern latitude forested ecoregions (Taiga and Hudson Plain) but also in Tundra. Outside of the high latitude ecoregions, P was >0.05 (two exceptions in Marine West Coast Forest) and were negative in eight out of 10 cases in the Great Plains. As for initial snowmelt and soil thaw, dates of lake ice breakup were related to SOS methods in the colder ecoregion ($P<0.05$ in Northern Forests, except HANTS-FFT) and less so in warmer ecoregions. In contrast to the cryospheric comparisons, the correlations of spring snowmelt onset date and the center of flow timing vs. SOS rarely had $P<0.05$ and were often negative. In the Great Plains, however, center of flow timing was significant and positive for six out of 10 SOS methods.

SOS assessment with plant phenology

We found that while no SOS method exhibited uniformly exceptional performance, the HANTS-FFT and Midpoint$_{pixel}$ methods were consistently more related to measured and modeled plant phenology than were other methods. Boxplots of the six phenological events showed two central patterns (Fig. 8). First, the median HANTS-FFT and Midpoint$_{pixel}$ were usually closest to the median of the spatially and temporally collocated

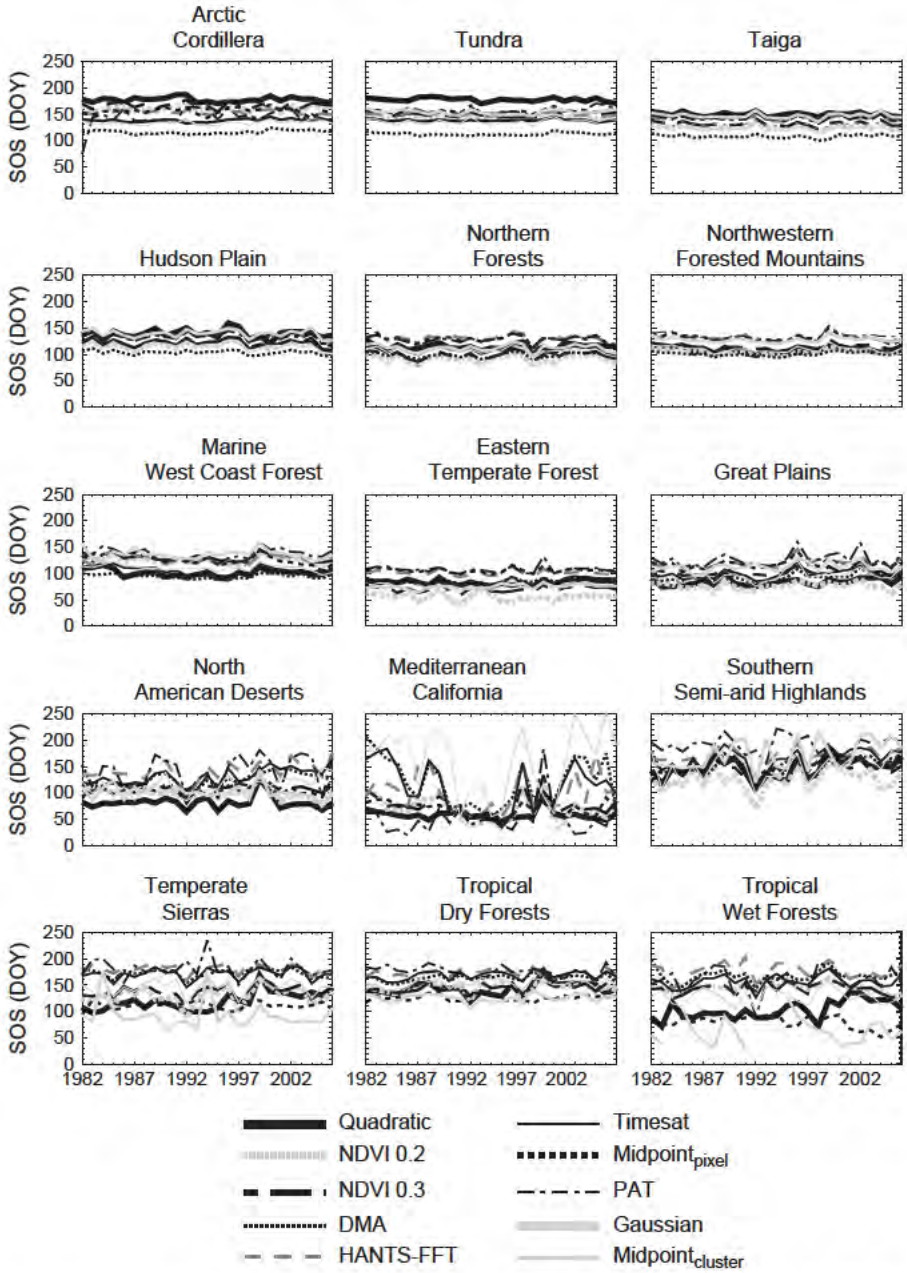

Fig. 6 Annual average start of spring (SOS) by ecoregion. Some methods and years are missing, e.g. for the Gaussian technique in Tropical Wet Forests.

measured phenology. Second, when compared across the phenological events, SOS methods were most similar in timing to first leaf such that interquartile ranges overlapped between measured phenology and seven of eight SOS methods (Gaussian and PAT were executed at the ecoregion level and are thus not comparable to ground locations).

When compared against specific measured phenology records, HANTS-FFT and Midpoint$_{pixel}$ again slightly outperformed other methods, but the strength of observed relationships was low (Figs 9 and 10). At the Bartlett Experimental Forest, SOS from the NDVI 0.2 and 0.3 methods was unrelated to the timing of increases in FPAR. In 2004, HANTS-FFT, Timesat, and Midpoint$_{pixel}$ SOS occurred within the measured increases in FPAR, but in 2005 and 2006 only HANTS-FFT and Midpoint$_{pixel}$ SOS were remotely within the FPAR increases. Results between HANTS-FFT and Mid-

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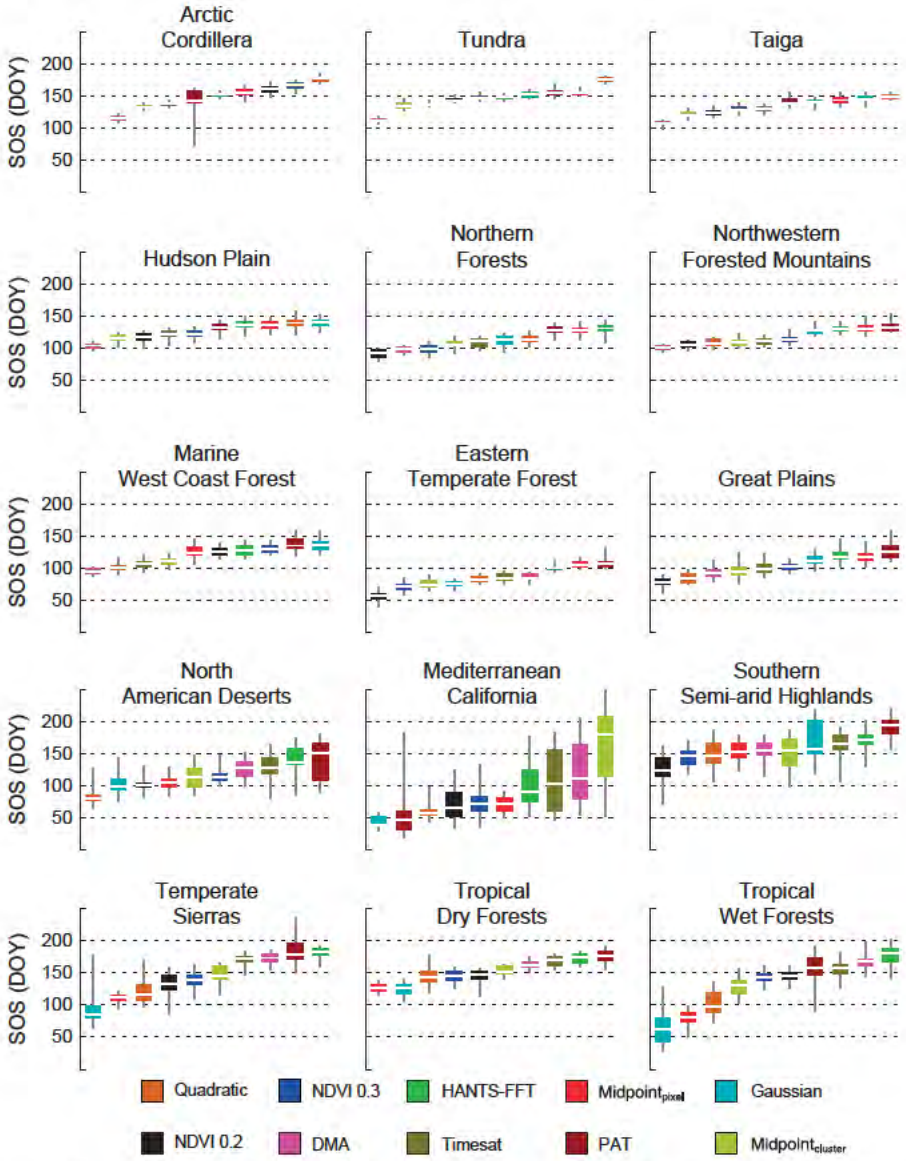

Fig. 7 Boxplots showing the distribution of start of spring (SOS) estimates across the 1982 2006 record for each ecoregion (box, interquartile range; white horizontal line, median; thin gray vertical lines, minimum and maximum). In each plots, boxplots are shown ordinally from earliest to latest method.

point$_{pixel}$ were inconsistent, with HANTS-FFT being earlier in 2004 and later in 2005 and 2006, while Midpoint$_{pixel}$ and Timesat had fairly consistent differences.

After screening data to include only time series with at least 10 years of data, we were able to assess 50 correlations between point-based measured phenology and pixel-based SOS (Fig. 10). P was rarely <0.05 (five out of 50 correlations for Quadratic and Midpoint$_{pixel}$, 10 out of 50 for HANTS-FFT, fewer for other methods). Averaged across the 50 time series, the highest mean correlations were for Midpoint$_{pixel}$ (0.35) and HANTS-FFT (0.33). Discounting NDVI 0.2 and NDVI 0.3, which were plagued by missing data, HANTS-FFT and Midpoint$_{pixel}$ also had the fewest number of negative correlations (two) among the SOS methods. The highest correlations for any comparisons were at the Rocky Mountain Biological Laboratory, where results had $P<0.05$ for seven of eight SOS methods.

HANTS-FFT and Midpoint$_{pixel}$ had the highest percentage of SOS estimates within the range and CIs of measured plant phenology for pixel-years with at least two unique plant observations (Fig. 11). For all SOS methods, estimates later than observed phenology CIs were rare (usually $<10\%$) and SOS estimates within the range of ground observed phenology never exceeded 40%. With the less stringent 90% CI comparison, Quad-

Table 3 Spearman's rank correlation coefficient for the relationship between the ten SOS methods shown as column headings and five independent cryospheric/hydrologic metrics shown from top to bottom as *shaded* headings and described in Appendix A

	Quadratic	NDVI 0.2	NDVI 0.3	DMA	HANTS-FFT	Timesat	$Midpoint_{pixel}$	PAT	Gaussian	$Midpoint_{cluster}$	Ecoregion average
Initial snowmelt											
Tundra	30	31	28	37	40	38	17	−17	45	12	26
					0.04				0.02		
Taiga	26	36	21	26	30	42	34	13	20	39	29
						0.04					
Hudson Plain	69	89	88	81	84	88	88	89	88	80	84
	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Northern Forests	63	64	59	60	28	57	34	39	41	46	49
	<0.01	<0.01	<0.01	<0.01		<0.01			0.04		
Northwestern Forested Mountains	46	44	41	18	12	35	29	11	24	23	28
	0.02	0.03	0.04								
Method average	47	53	47	44	39	52	40	27	44	40	
SSM/I soil thaw											
Arctic Cordillera	6	40	38	−38	47	−35	11	20	NA	13	11
					0.05						
Tundra	49	63	61	−2	54	48	61	65	50	57	51
	0.04	0.01	0.01		0.02	0.04	0.01	<0.01	0.03	0.01	
Taiga	67	66	53	64	57	68	55	58	53	66	61
	<0.01	<0.01	0.03	<0.01	0.01	<0.01	0.02	0.01	0.02	<0.01	
Hudson Plain	83	70	68	65	35	59	54	60	50	48	59
	<0.01	<0.01	<0.01	<0.01		0.01	0.02	0.01	0.04	0.04	
Northern Forests	56	44	48	27	20	48	34	35	30	40	38
	0.02		0.04			0.04					
Northwestern Forested Mountains	−4	32	31	33	30	27	27	27	33	25	26
Marine West Coast Forest	29	35	24	33	41	13	19	48	8	61	31
								0.04		0.01	
Eastern Temperate Forest	40	−3	20	46	14	39	28	34	16	46	28
Great Plains	−2	−30	−6	−6	−17	−12	−4	3	4	−22	−9
Method average	36	35	37	25	31	28	32	39	27	37	
Lake ice breakup											
Northern Forests	62	62	67	57	22	62	44	55	52	54	52
	<0.01	<0.01	<0.01	<0.01		<0.01	0.04	0.01	0.01	0.01	
Eastern Temperate Forest	16	53	40	13	24	24	20	32	0	15	24
		0.01									
Great Plains	5	26	17	11	−2	7	7	0	23	−10	8
Method average	28	47	41	27	15	31	24	29	25	20	
Spring snowmelt onset date											
Northwestern Forested Mountains	−16	−18	−11	23	−27	−14	−40	2	1	−23	−12

Continued

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Table 3. (*Contd*)

	Quadratic	NDVI 0.2	NDVI 0.3	DMA	HANTS-FFT	Timesat	$\text{Midpoint}_{\text{pixel}}$	PAT	Gaussian	$\text{Midpoint}_{\text{cluster}}$	Ecoregion average
							0.05				
Marine West Coast Forest	35	11	13	5	−25	7	−15	17	−21	−12	2
North American Deserts	24	37	36	38	39	34	30	32	29	28	33
Method average	14	10	12	22	−4	9	−8	17	3	−3	
Center of flow timing											
Northern Forests	7	1	−2	−3	−9	−21	−14	−5	−6	−17	−7
Northwestern Forested Mountains	50	39	40	30	11	39	32	41	38	28	35
	0.01		0.05					0.04			
Marine West Coast Forest	7	−4	−3	−10	−52	−13	−34	−18	−33	−49	−21
					0.01					0.01	
Eastern Temperate Forest	−13	25	12	−35	−33	−19	−30	−19	−22	−33	−17
Great Plains	41	35	49	47	42	52	39	49	28	22	40
	0.04		0.01	0.02	0.04	0.01		0.01			
North American Deserts	4	−36	−42	18	21	16	16	25	−10	9	2
			0.04								
Mediterranean California	12	6	11	20	−14	13	21	3	7	4	8
Temperate Sierras	−11	−4	−6	40	24	12	−1	−13	−14	−2	3
				0.05							
Method average	12	8	7	13	−1	10	4	8	−1	−5	

For each method, only those ecoregions containing the relevant information are shown (e.g. no snowmelt data available for most tropics). For visual clarity, coefficients are shown multiplied by 100 and rounded such that a value of 30 represents a value of 0.30. Averages for each ecoregion are shown in the last column and for each SOS method in the last row of each set of comparisons. *P*-values less than the standard cutoff for significance of 0.05 are shown on the second line of each cell (see section 2 for discussion).

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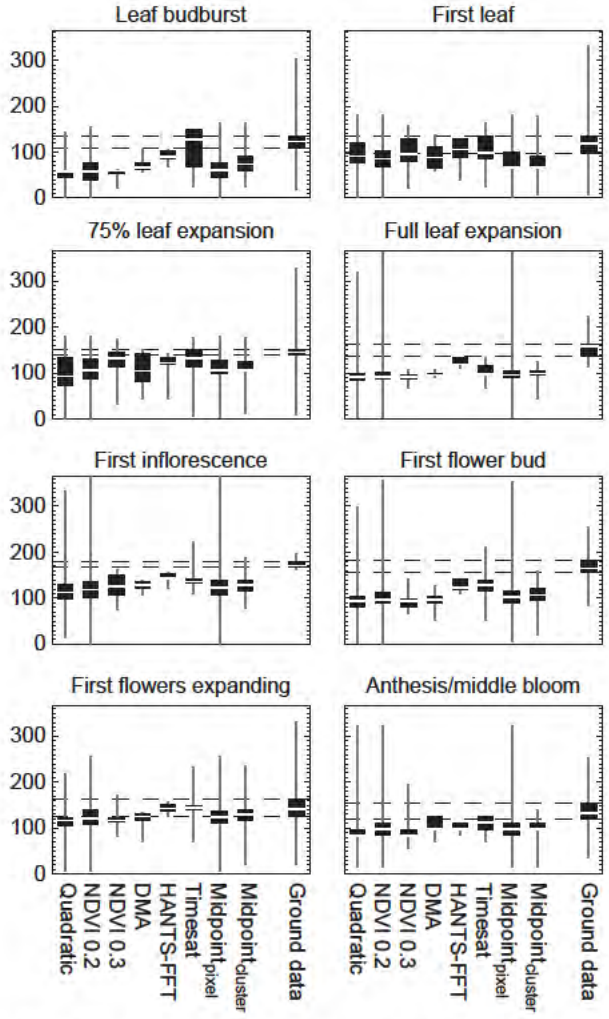

Fig. 8 The relationship between ground measured phenological stage (panel headings) and SOS estimates. Boxplots: black box, interquartile range; white line, median; thin gray vertical lines, minimum and maximum. Dashed lines show the upper and lower quartile of the ground data. Note that the geographic and temporal coverage of the phenological stages is variable, i.e. the boxplots are not a comparison of SOS vs. ground data at the same location and times and should be taken as an approximate indication of the relative timing of SOS vs. ground phenology: SOS is almost always earlier, often by several weeks.

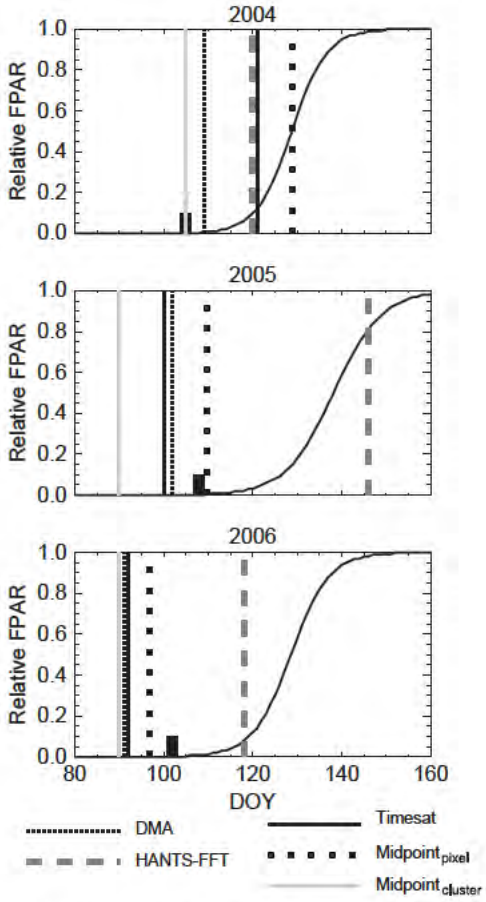

Fig. 9 SOS estimates for the Bartlett Experimental Forest. Black sigmoidal curve shows the site measured FPAR on a relative scale (0 annual minimum; 1 annual maximum). Vertical lines show the SOS estimate from individual methods. SOS estimates for NDVI 0.2, and NDVI 0.3 methods were always earlier than DOY 80 and are not shown; Quadratic was earlier than DOY 80 except in 2006 when it overlapped with DMA and is thus not drawn; PAT and Gaussian methods are not shown as they were implemented at the ecoregion, not pixel, level. Short, thick black line shows date of soil thaw at 5 cm depth.

ratic, NDVI 0.2, NDVI 0.3, DMA, Timesat, and Midpoint$_{cluster}$ had nearly half or more of SOS estimates before the observed CI. Only HANTS-FFT and Midpoint$_{pixel}$ had more than 60% of SOS estimates within the observed CIs (66% and 69%).

In comparisons against the 1982–1999 annual dates of ground-measured spring arrival (all stages, Table 2), only HANTS-FFT and Midpoint$_{pixel}$ had the desired combination of high R^2, a low bias, and a reduced major axis regression slope close to 1 (Fig. 12). Timesat and Midpoint$_{cluster}$ had high R^2 and consistently large biases towards early SOS estimates. All methods besides HANTS-FFT and Midpoint$_{pixel}$ had offsets larger than 3 weeks and only Midpoint$_{pixel}$ had bias <1 week. NDVI 0.2 and NDVI 0.3 had R^2 close to zero. Expressed as time series plots, Midpoint$_{pixel}$ tracked the ground-measured phenology with low bias but some evidence of excessive interannual variability in the mid 1990s (Fig. 12). HANTS-FFT was more biased towards earlier predictions but had interannual variability more consistent with ground-measured phenology.

For the Eastern Temperate Forest comparisons of modeled plant phenology vs. satellite estimates, SOS was related (P<0.05) to SI first bloom for six of 10

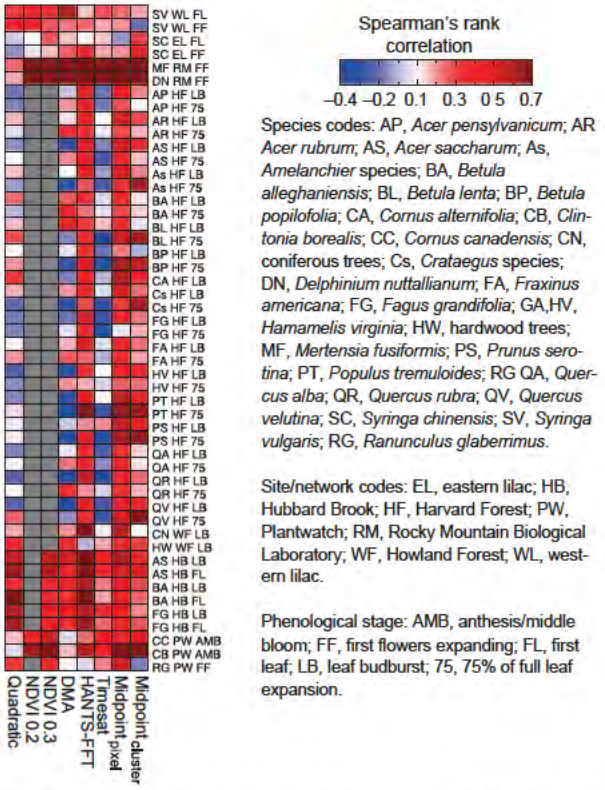

Fig. 10 Spearman's rank correlation coefficients between ground measured phenology and SOS estimates for the corresponding years and location. Shown are records of at least 10 years in duration. Blue colors indicate negative correlations; red colors positive correlations; gray indicates missing SOS estimates. Each column shows one SOS method; each row shows one ground record. Text to the right of the colored panels shows species, site or network, and phenological stage (see in figure text for code explanations). For EL, PW, and WL comparisons are based on annual averages at multiple locations; otherwise comparisons are for individual sites. PAT and Gaussian methods not shown as they were implemented at the ecoregion, not pixel, level.

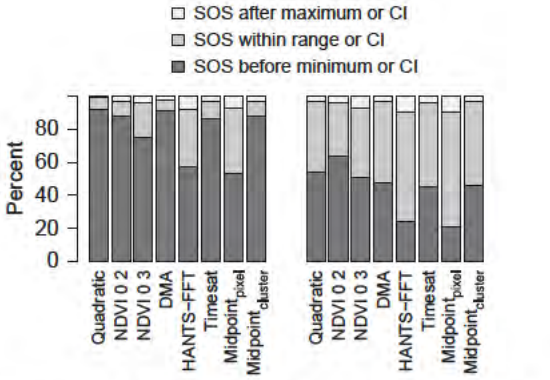

Fig. 11 Comparison of SOS methods against ground data. For each 8 km pixel containing at least two ground observations within a year (any species or phenological event), the range and 90% confidence interval (CI) were constructed for the ground observations; SOS estimates were then categorized as before the minimum or CI, within the range or CI, or after the maximum or CI. Comparisons are range in the left panel and CI in the right panel. All ground data for which valid satellite retrievals existed (ranging from a low of 1848 pixel year records for NDVI 0.2 to a high of 3046 for HANTS FFT) were used a separate assessment was conducted using only pixel year records found in all eight methods but results were consistent and are not shown. PAT and Gaussian methods not shown as they were implemented at the ecoregion, not pixel, level.

methods with an average value of 0.41 (Table 4). SI first bloom correlations were highest for HANTS-FFT, the three conceptually linked methods ($Midpoint_{pixel}$, $Midpoint_{cluster}$, and PAT), and NDVI 0.3. SI first leaf was related ($P<0.05$) only to NDVI 0.2 while $D_{leaf\text{-}out}$ was related (at $P<0.05$) to NDVI 0.2 and NDVI 0.3. We graphically present results for the HANTS-FFT and $Midpoint_{pixel}$ methods selected as most consistent with these and the preceding ground phenology data (Fig. 13). As for the comparison with measured plant phenology, $Midpoint_{pixel}$ was consistent with the absolute dates of both the SI first bloom and $D_{leaf\text{-}out}$ models while HANTS-FFT was slightly biased towards early estimates. Modeled SI first leaf was approximately 1 month earlier.

Trends

Trends in spring arrival were insignificant for both: (1) measured ground phenology, HANTS-FFT, and $Midpoint_{pixel}$ for North America from 1982 to 1999 (Fig. 12); and (2) SI first leaf and first bloom, $D_{leaf\text{-}out}$, HANTS-FFT, and $Midpoint_{pixel}$ for the US Eastern Temperate Forest from 1982 to 2003 (Fig. 13). Assessed at a more detailed level for the 182 level 3 ecoregions (Supporting Information, Figure S1), trends existed ($P<0.05$) for 30 of 182 ecoregions in HANTS-FFT (20 towards earlier SOS and 10 towards later SOS) and for 24 of 182 ecoregions in $Midpoint_{pixel}$ (15 towards earlier SOS and nine towards later SOS). Only five ecoregions had $P<0.05$ for trends in both methods (two for earlier SOS and three for later SOS). When using HANTS-FFT and $Midpoint_{pixel}$ as simultaneous y-vectors, however, 30 ecoregions had $P<0.05$ for trends (Fig. 14). A total of 12% of land area had a trend with $P<0.05$; earlier trends (7%) slightly exceeding later trends (5%).

Discussion

Our results indicate that given NDVI data with identical duration, satellite correction scheme, geographic region, compositing scheme, and spatial resolution, SOS estimates differed in terms of average DOY by more than 1

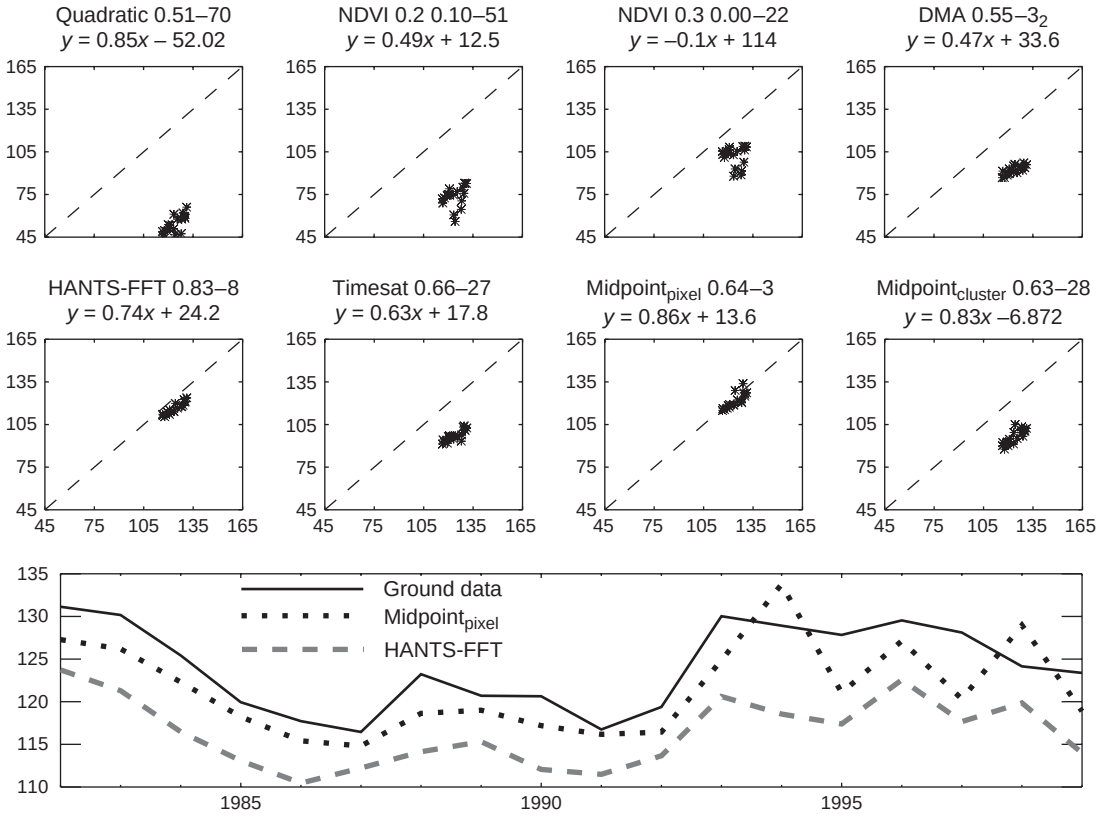

Fig. 12 Comparison of 1982 1999 ground observed phenology and SOS (post 1999 data not used due to very limited ground data availability). Analysis is for all pixel years containing at least two ground observations of any species and any phenological stage and only for pixel years present for all SOS methods. Ground data were first averaged to pixel year and then for all of North America. Small panel titles are: SOS method, R^2, and bias (in days) on the first line and the reduced major axis linear model on the second line. The bottom panel shows the ground data and the two SOS methods with bias close to zero, slope near one, and high R^2. All Spearman's Rank Correlations showed no trends in SOS or ground phenology ($P > 0.05$). Analysis conducted only for those pixels present for all SOS methods.

month (Fig. 2), variability by more than 2 weeks (Fig. 3), retrieval ability by more than one-third (Fig. 4), and ordinal ranking by latitude (Fig. 5) and ecoregion (Figs 6 and 7). Other work has noted that differences exist among SOS methods (Reed *et al*., 2003) and ecoregions (Bradley & Mustard, 2008), but an expectation, or perhaps a hope, has existed in the remote sensing community that SOS methods may have consistent ordinal behavior and may simply be detecting different portions of the annual vegetation phenological developmental cycle. We do not find evidence to support this supposition. Independent of interpretive and assessment data, such an intercomparison of SOS methods would have no rational basis for selecting one method over another method.

When taken in the context of interpretation with cryospheric/hydrologic metrics and assessment with plant phenology observations and models, we believe that our intercomparison may be a useful way of identifying the strengths and weaknesses of particular methods and SOS approaches in general. First, we suggest that methods based on global thresholds (including the hybrid Gaussian method) be abandoned for continental to global applications. The NDVI 0.2 and NDVI 0.3 methods – based on NDVI exceeding a geographically constant threshold – had excessively low retrieval rates (Figs 4 and 10, usually because annual NDVI did not fall below the threshold) and essentially no relationship with measured patterns of interannual phenology variation (Fig. 12). The Gaussian method, which relies on a range of absolute thresholds, had similarly large failure rates for much of North America (Fig. 4). Limited cases of high correlations suggest, i.e. for cryospheric comparisons (Table 3) or $D_{\text{leaf-out}}$ (Table 4), that absolute thresholds may be appropriate for geographically limited application in specific ecosystem; such ability, however, is more than offset by inapplicability over much of North America for the global threshold or hybrid methods.

Second, differences in the implementation of a related method may produce quite different results, as in the case of Midpoint$_{pixel}$ and Midpoint$_{cluster}$. We executed

Table 4 Spearman's rank correlation coefficients for the 1982 through 2003 relationship between the ten SOS methods shown as column headings and modeled phenology

	Quadratic	NDVI 0.2	NDVI 0.3	DMA	HANTS-FFT	Timesat	$Midpoint_{pixel}$	PAT	Gaussian	$Midpoint_{cluster}$	Phenological stage
First leaf	35	46	41	24	24	29	29	38	7	34	21
		0.03									
First bloom	8	37	51	38	55	43	53	56	13	54	41
			0.02		0.01	0.05	0.01	0.01		0.01	
$D_{leaf-out}$	5	44	22	11	44	11	22	22	14	18	31
		0.04			0.04						
Method average	16	42	38	24	41	27	35	39	11	35	

First leaf and first bloom simulations are from the Spring Indices models based on clonal lilac and honeysuckle species; $D_{leaf-out}$ is an estimation of the day at which the ecosystem becomes a net carbon sink as measured by eddy covariance and is related to the timing of leaf-out by overstory trees. Results are shown only for the eastern temperature forest ecoregion in which the models were developed. For visual clarity, coefficients are shown multiplied by 100 and rounded such that a value of 30 represents a value of 0.30. Averages for each phenological stage are shown in the last column and for each SOS method in the last row. *P*-values less than the standard cutoff for significance of 0.05 are shown on the second line of each cell.

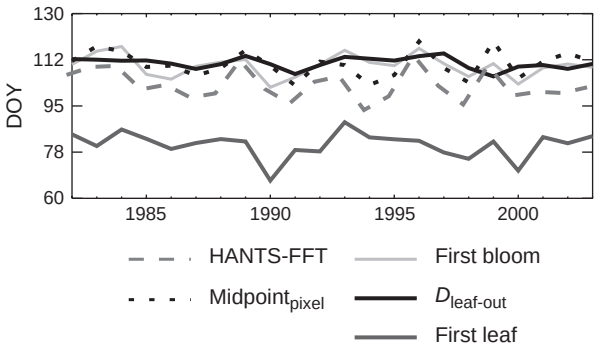

Fig. 13 1982 2003 comparison of SOS estimates and modeled spring phenology. Models (shown by solid lines) are first bloom and first leaf from the Spring Indices models based on clonal lilac and honeysuckly phenology and $D_{leaf-out}$ based on the date at which ecosystems become net carbon sinks, as measured by eddy covariance. Data are shown for the Eastern Temperate Forest ecoregion within the conterminous United States (area covered by meteorological inputs required for models). See Table 3 for statistics for all SOS methods. Note that curves for HANTS FFT and $Midpoint_{pixel}$ represent a different study area and duration than the curves shown in Fig. 12.

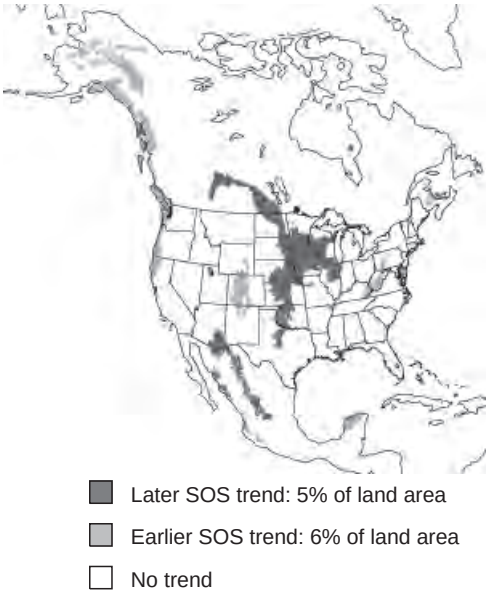

Fig. 14 Location of trends in 1982 to 2006 SOS with $P<0.05$ calculated using the HANTS FFT and $Midpoint_{pixel}$ methods.

$Midpoint_{pixel}$ for individual pixels and used a spline to fit sub-daily time steps and a detailed removal of undesirable time series; for $Midpoint_{cluster}$, we used a regionalization concept, measures of uncertainty around the threshold, and a 15-day time step (see Appendix A). When retrieved SOS is regressed on ground observations, both methods had similar R^2 and slope but $Midpoint_{cluster}$ had a bias of about 1

month, thus highlighting the importance of implementation details on SOS results (Fig. 12).

Third, SOS methods were frequently incapable of retrieving estimates for desert and tropical ecoregions or ecoregions in which the initiation of growth spans the start of the calendar year (Fig. 4). In these areas, when retrievals were obtained, the variance among methods was high (Figs 6 and 7). In addition, few independent data on cryospheric/hydrologic metrics were available for desert or tropical system. SOS for Mediterranean California, an ecoregion with a pronounced and regular wet and dry season, was inconsistently estimated (Figs 2, 3, 6 and 7). The switch from dry to wet occurs around the end of December to early January, and the SOS methods' variable treatment of calendar years vs. a continual time series likely influenced these results. Whenever possible, we recommend the extraction of SOS estimates from continual time series.

Fourth, we have established that for level 1 ecoregions, SOS estimates are related to cryospheric dynamics, especially in the colder and snowier ecoregions, but less so to hydrologic dynamics (Table 3). Our results support the contention that for evergreen forested ecoregions, the annual cycle from near-total snow cover to a mature canopy provides a distinct and detectable NDVI cycle, arguing for further development of techniques designed to extract a pure vegetation phenology cycle (Delbart *et al.*, 2005).

The spring snowmelt onset date is designed to be a proxy indicator of when temperatures rise above freezing and stay there. It is likely that for Northwestern Forested Mountains and Marine West Coast Forests, the snowmelt metric is too early to track spring phenological development and thus high correlation would be unexpected. In ecoregions with spatially variable snowmelt inputs and/or where a snowmelt pulse does not persistently dominate streamflow, short-term precipitation variability and timing becomes more influential. Thus, in the North American Deserts, where all correlations were positive but had $P > 0.05$, we speculate that phenology is likely to be related to snowmelt timing, unimodal and bimodal precipitation distribution, and moisture availability, and that the low correlations may be related to persistently low SOS retrieval rates (Fig. 4).

For the center of flow timing, the low correlations in forested systems may again reflect the wrong event for comparisons to spring phenology or a strong signal from watersheds with the most snow (usually highest elevation) rather than the most area. In the southern Great Plains, where water limits can be important and many streamflow records are not dominated by a unimodal snowmelt pulse, the timing of water delivery may influence interannual phenological timing, leading to correlations with $P < 0.05$ for some SOS methods (Table 3). It is possible that different hydrologic measures tuned towards different stages of the hydrograph could be more related to SOS; we recommend that further research explore this possibility.

Fifth, based on a suite of information (Figs 8, 9, 11 and 12), we have established that in most cases, SOS estimates occur before measured phenological events. Even in the case where SOS estimates most overlapped with ground observations (first leaf, Fig. 8), satellite dates were usually earlier than ground dates. While the consistent SOS vs. ground measurement bias may be caused by SOS detections being more related to snow dynamics (Table 3; see Fig. 10 for high correlations at Rocky Mountain Biological Laboratory, a site with large NDVI amplitude from snow cover to mature conifer forest) and/or ground networks being biased towards species with relatively late phenologies, our results suggest that observations of first leaf may be most useful for future assessment of SOS methods.

Sixth, although we have attempted to minimize the difficulties inherent in an extremely diverse ground phenology dataset (Fig. 1), we acknowledge that the ground data were not collected with an explicit purpose of satellite assessment; our analysis is thus subject to classical point-vs.-pixel comparison errors. In essence, without remote sensing capable of resolving individual crowns or more detailed sampling schemes, it is not known whether or not the recorded species reflect the overall phenological development of an entire 8 km pixel. While these caveats represent a potentially important source of variation generating unknown uncertainty, our overall results suggest that, in comparison with ground data, the HANTS-FFT and $\text{Midpoint}_{\text{pixel}}$ methods have: about 65% acceptable SOS retrievals (Fig. 11), correlations that are > 0.6, low offsets or bias, and regression slope near 1. For implementation purposes, we note that some methods require complete time series and are best suited for research purposes (i.e. HANTS-FFT which requires data extending well past extracted SOS dates) while others, such as PAT (which is strongly related to $\text{Midpoint}_{\text{pixel}}$ above about 35° and is simple to implement, Fig. 5), are optimized for real-time implementation

Finally, evidence from measured (Fig. 12) and modeled (Fig. 13) phenology supports our findings of very limited SOS trends towards earlier spring arrival (Fig. 14), which are broadly consistent with some satellite results (Reed *et al.*, 2003) and opposite others (Zhang *et al.*, 2007). In our two-way comparison of independent trends estimated between the HANTS-FFT and $\text{Midpoint}_{\text{pixel}}$ methods, we found numerous ecoregions with trends towards both earlier and later SOS ($P < 0.05$), but the locations differed and only five of

182 level 3 ecoregions had $P<0.05$ in both methods. However, for all cases except one, when one method had a $P<0.05$, the sign from the other method was the same, suggesting a measure of consistency that is supported by the 30 ecoregions with $P<0.05$ when using the ensemble approach (Fig. 14). We therefore submit that an ensemble approach of multiple SOS methods may be more powerful for trend estimation than use of single methods alone.

Ground-based observations of cryospheric/hydrologic metrics and plant phenology over longer time periods have tended to show trends consistent with climate warming. For example, trends toward earlier peak snowmelt runoff have been found in the western US during 1948–2002 (Stewart *et al*., 2005) and earlier ice breakup on lakes and rivers across the northern hemisphere has been observed during 1846–1995 (Magnuson *et al*., 2000). Trends towards earlier spring have been found during 1951–2000 for agrometeorological indices in the western US (Feng & Hu, 2004); 1954–1994 for lilac and honeysuckle phenology in the western US (Cayan *et al*., 2001); and 1959–1993 for last 2.2 °C frost date and for SI-modeled first leaf and first bloom (Schwartz & Reiter, 2000). However, results from experimental warming suggest that plants which develop later in the summer may be less likely to respond to climate change by advancing their phenology or may even show trends toward later phenology (Sherry *et al*., 2007).

Satellite SOS trend estimates are limited by a short record (Myneni *et al*., 1997) and are thus often incomparable with longer, climatically driven analyses. We note, however, that measured and remotely sensed estimates for North America both suggest a trend towards earlier spring until the early 1990s followed by a step change to later spring around 1993 – a change that is largely consistent with approximately 0.5 °C decreases in post-1993 December to May temperatures for most of North America except the desert southwest (Figure S2). Other studies have shown trend reversals in measured phenology consistent with seasonal temperature variations or changes in synoptic pressure systems (Scheifinger *et al*., 2002; Schaber & Badeck, 2005).

Conclusions

We conducted an intercomparison, interpretation, and assessment of 10 SOS methods for North America from 1982 to 2006. We demonstrate that SOS estimates vary extensively within and among methods and that independent of other ecosystem information, selecting the strongest method or calculating ensemble methods would be difficult. Based on relationships with independent measures of cryospheric interannual variability and measured and modeled plant phenology, we identify two SOS methods most consistent with currently available corroborating data.

Trend estimates from the SOS methods as well as measured and modeled plant phenology strongly suggest either no or very geographically limited trends towards earlier spring arrival, although we caution that, for an event such as SOS with high interannual variability, a 25-year SOS record is short for detecting robust trends. Increased greenhouse warming since the late 20th century would seem to argue for increased, not decreased, shifts in spring during our study period, indicating that processes such as succession, changes in community structure, land management, or disturbance may be more important than previously recognized. Seasonal temperature changes may also be linked to a trend reversal in SOS in the early 1990s.

Our results highlight both the challenge and potential for integrating remote sensing and ground observations. No other technology besides remote sensing offers wall-to-wall coverage and consistent long-term monitoring, yet few metrics of biospheric response are as unconstrained by appropriate ground data – our study clearly outlines the limitations in using existing historical datasets. Establishing consistent plant phenology monitoring networks (e.g. the USA National Phenology Network, http://www.usanpn.org, (Betancourt *et al*., 2007), or the European Phenology Network) as well as incorporating a broader consideration of non-climatic factors influencing SOS estimates is therefore critical. A specific suggestion is to integrate SOS estimates with ground measurements of first leaf (to which SOS estimates from the two selected methods are most related) in a geographically focused area with broad correspondence among cryospheric/hydrologic metrics and phenology, such as the Hudson Plain ecoregion. A focused approach would also permit assessment of within-ecoregion variability, which was beyond the scope of the current analysis. Similar analyses and study selections could be replicated on other continents to produce a network of phenological monitoring ecoregions.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Fig. S1. Map of the level 3 ecoregions.

Fig. S2. December to May average air temperatures for the 1994 to 2006 minus the 1988 to 1992 period. Purple colors show cooling in the later period. Data and figure obtained through the NCEP/NCAR Reanalysis project (http://www.cdc.noaa.gov/ncep reanalysis/).

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Appendix A

Satellite SOS estimates

SOS category 1: global thresholds

In this simplest of methods, SOS is determined as the DOY that NDVI crosses a threshold in the upward direction where the same threshold is used globally, i.e. for every pixel. To determine at which DOY the threshold is reached, the time series is interpolated to a daily dataset. In this study we have used threshold levels of 0.2 and 0.3 with no filtering or smoothing of input NDVI time series and term the methods NDVI 0.2 and NDVI 0.3.

SOS category 2: local thresholds

Instead of a global threshold, a locally tuned NDVI threshold is used (White *et al*., 1997) wherein the state of the ecosystem is indexed by transforming the NDVI to a 0 to 1 $NDVI_{ratio}$ as

$$NDVI_{ratio} = \frac{NDVI \quad NDVI_{\min}}{NDVI_{\max} \quad NDVI_{\min}}, \qquad (1)$$

where NDVI is the daily NDVI and $NDVI_{max}$ and $NDVI_{min}$ are the annual maximum and minimum of the NDVI curve. SOS is defined as the DOY when 0.5 $NDVI_{ratio}$ is exceeded (note that an absolute rather than relative threshold may be used as simply the midpoint between the minimum and maximum NDVI). The 0.5 is designed to correspond to the timing of maximum NDVI increase; some evidence suggests that this corresponds to the initial leafing of the overstory canopy (White *et al*., 2000). Here three variations on this method have been applied: $Midpoint_{pixel}$, $Midpoint_{cluster}$, and PAT. For $Midpoint_{pixel}$, we set SOS to missing if any of the following occurred: more than 10% of observations were missing from the total 25 year time series; for any year, at least one observation was missing from composite periods 1, 2, 11, 12, 13, 14, 23, or 24 (determined to be critical for the detection of $NDVI_{max}$ and $NDVI_{min}$); more than three observations were missing during a year. For all the other pixels, we used a cubic smoothing spline to interpolate the composited data to a 0.5-day resolution and calculated $NDVI_{max}$ and $NDVI_{min}$ by a 7-day moving average. In the case of multiple solutions for SOS (e.g. a nonbell-shaped curve), we determined SOS as the earliest day with the increasing rate.

For $Midpoint_{cluster}$, we initially clustered pixels into homogenous clusters (White *et al*., 2005) with similar biological and physical characteristics, as defined by land cover (Loveland *et al*., 2000), monthly temperature and precipitation (Leemans & Cramer, 1991), and GTOPO30 elevation binned to 500 m increments. Within each cluster we averaged NDVI for each composite period and used the midpoint approach where the SOS threshold was defined as the half-maximum NDVI $\pm$ an error threshold (NDVI 0.025 for vegetation with maximum NDVI <0.5, otherwise 0.05). For $Midpoint_{cluster}$ we did not estimate SOS if maximum NDVI was <0.1 and determined SOS DOY as the SOS composite period multiplied by 15 (average composite period length).

We also used a variant of the Midpoint technique called percent-above-threshold [PAT, (White & Nemani, 2006)] in which the behavior of a group of pixels within

a level 3 ecoregion (Fig. S1) is tracked. In PAT, SOS is defined as the date at which 50% of pixels within an ecoregion have exceeded the median ecoregion midpoint NDVI (similar to 0.5 $NDVI_{ratio}$ but defined as an absolute NDVI). We defined PAT SOS only for those ecoregions in which only a single SOS was defined in each of the 25 study years.

SOS category 3: conceptual-mathematical

Here, an assumption is made that a particular mathematical function or suite of functions may be used to represent phenological development. We used two groups of conceptual mathematical models: smoothing methods and model fit methods.

For the smoothing methods, we first determined SOS with the delayed moving average method (DMA, (Reed *et al.*, 1994)), in which SOS is the DOY at which a smoothed NDVI time series crosses a curve established from moving average models with an introduced time lag of fifteen composites, i.e. SOS occurs when the true NDVI exceeds the predicted NDVI of the prior composite periods.

Second, in the HANTS-FFT method, we used the HANTS-FFT algorithm (Roerink *et al.*, 2000) to iteratively fit a series of frequencies to the NDVI profile (mean, yearly and half-yearly cycle) with the returned fast Fourier transform (FFT) coefficients then used to reconstruct the NDVI profile on a daily basis [reconstruction quality usually increasing with the number of component sinusoidal waves (Jakubauskas *et al.*, 2001; Wagenseil & Samimi, 2006)]. SOS is derived as the point of maximum increase on the NDVI profile. Although the HANTS algorithm is robust, the estimation of SOS indicators may become unstable when there is no distinct phenological cycle and dual growing seasons are not detectable in the version of the algorithm used here.

For the model fit methods, we first used the Quadratic method (de Beurs & Henebry, 2008) and a model of the form

$$\mathrm{NDVI} = \alpha + \beta \mathrm{AGDD} + \gamma \mathrm{AGDD}^2, \qquad (2)$$

where AGDD are the accumulated growing degree-days in °C calculated from the North American Regional Reanalysis (Mesinger *et al.*, 2006). We applied an exhaustive search algorithm that fits every pixel time series with multiple seasonal windows of differing length and starting period (best fits usually obtained if only the warm season data – usually April to October but variable by pixel – were used and preceding composites with low and static NDVI were excluded). The Quadratic method estimates SOS for each pixel-year as the first composite period of the best fitting model.

Second, in the Timesat method (Jönsson & Eklundh, 2004), we used a model fit consisting of a number of local model functions merged into a global function, thus allowing the fitted function to follow the behavior of the time series (not possible with a simple Gaussian model or lower order Fourier transform (Jönsson & Eklundh, 2002)). In this Timesat implementation, we used a local quadratic polynomial fit and the adaptive Savitzky-Golay filter applied to a moving window size of seven composites. We eliminated NDVI spikes larger than two times the standard deviation of the median values of the closest neighbors in the time series and fitted the remaining upper envelope. SOS is defined from the global model as the interpolated composite period when the NDVI has increased 20% of the seasonal amplitude from the growing season minimum level. Although the threshold level can be adjusted, the 20% threshold has been used effectively (Jönsson & Eklundh, 2002; van Leeuwen, 2008). We estimated SOS DOY values by the interpolated composite period multiplied by 15 days.

SOS category 4: hybrid

In the Gaussian method (closely related to an earlier Weibull curve approach, (Myneni *et al.*, 1997)), which we applied at the level 3 ecoregion level (Fig. S1) as opposed to pixel by pixel (as for PAT), we first calculated the mean NDVI for each ecoregion for each composite period. In the next step, we fitted a Gaussian curve to the composites from April 1 until October 31 with SOS determined as the average DOY when the fitted NDVI curve reached 0.30, 0.35 and 0.40 (SOS not determined if the samples contain missing data or if the maximum value of the composites is <0.4). The Gaussian method is thus a hybrid of a conceptual mathematical model and a global threshold model.

Cryospheric/hydrologic comparisons

Snow

We used the 1982–2006 Northern Hemisphere weekly snow cover version 3 product from the National Snow and Ice Data Center [NSIDC, based on visual interpretations of multiple satellite inputs (Armstrong & Brodzik, 2005)]. For each week and ecoregion, we calculated the percent snow free (including NSIDC classes: snow, quality control snow, ice, quality control ice but dominated by variability in snow) and then selected only those ecoregions in which the percent snow free fell below 20% and rose above 80% in all years. For each year, we subsetted a vector from January 1 to the DOY at

which percent snow free exceeded 95% of the annual maximum (95% used because of frequent long plateaus slightly <100%) and then calculated a normalized cumulative distribution function (CDF) such that January 1 was 0 and the date of 95% snow free was 1. We extracted the dates of initial, midway, and complete snowmelt (0.05, 0.5, and 0.95 on the normalized CDF).

Soil thaw

We used 1988–2005 estimates of the date of spring thaw from 19-GHz brightness temperatures recorded by the Special Sensor Microwave/Imager (SSM/I) on both the 06:00 and 18:00 hours equatorial crossing satellites. We compared both the am and pm products; we present results from the am estimates only, for which we found correlations to be consistently higher. Full details are available (Kimball *et al*., 2006) but the method relies on detecting a step change in the landscape dielectric constant as water changes from a frozen to liquid state, with concomitant increases in brightness temperature. The method is functional only in high latitude areas undergoing hard winter freezes.

Lake ice dynamics

We used 1982–2004 maps of ice breakup date created from ground-based observations on 65 water bodies in Minnesota, Wisconsin, Michigan, Ontario, and New York (Jensen *et al*., 2007). We projected water body locations and removed first order spatial (x and y) trends before variogram fitting (spherical model) and kriging (ArcView v8.3, Geostatistical Analyst Extension). The spatial extent of predictions was limited to the x and y extent of the observations and we made no predictions greater than 200 km from the nearest breakup date observation. Five lakes did not freeze in 2002, and one did not freeze in 1998; for these lakes and years, we used an existing method and inferred a breakup date by taking the average midpoint between the freeze and breakup dates of the five winters with the shortest ice durations (Assel & Robertson, 1995).

Spring hydrology

We used 1982 to 2006 indicators of spring hydrology calculated for 1149 stream gages in the US Geological Survey Hydroclimatic Data Network (locations believed to measure flows that are largely devoid of upstream diversions, reservoirs, and land use changes (Landwehr & Slack, 1992). We calculated the spring snowmelt onset date as the DOY when a snow-fed stream begins its rapid rise – defined as the day when the cumulative departure from annual mean flow is minimum – associated with the onset of major snowmelt (Cayan *et al*., 2001) (calculated only for stream gages that are reliably snow-fed, as defined by expert judgment). We also calculated the center of flow timing as the 'center of mass' of the hydrograph for each gage each water year. The center of flow is approximately, but not exactly, the date by which half the annual flow has passed and is described in more detail elsewhere (Stewart *et al*., 2004, 2005). Although both indices are designed to isolate temperature influences, precipitation timing may influence some records, especially in non-mountainous regions. We restricted our analyses to those ecoregions with at least 10 stream gages.

Modeled plant phenology

First, we used the Spring Indices (SI) model (Schwartz, 1997, 2003), which incorporates data from about 190 sites recording lilac (*Syringa chinensis*) and honeysuckle (*Lonicera tatarica*, *L. korolkowii*) phenology in the northeastern US. A step-wise multiple regression model combines the phenology observation with climatic indices (such as accumulation of winter chill and heat accumulation) to predict, among other events, first leaf and first bloom. Second, we used a model based on eddy covariance measurements of CO_2 exchange recorded at 12 deciduous forest sites from 36°N to 53°N. The model assumes that the start of spring ($D_{\text{leaf-out}}$) occurs at the onset of canopy photosynthesis when daily net CO_2 exchange transcends from the winter respiration phase to the spring/summer assimilation phase (Baldocchi *et al*., 2005). Conceptually, $D_{\text{leaf-out}}$ occurs when mean daily soil temperature equals and then surpasses the mean annual air temperature and may be calculated (Baldocchi *et al*., 2005) using air temperature alone:

$$D_{\text{leaf-out}} = 169.3 \quad 4.84 \times \text{mean annual air temperature}. \qquad (4)$$

Since trees are unable to sense the mean annual air temperature *a priori*, we estimated mean annual temperature with a 2-year running mean. For both models, we used meteorological inputs from 1982 to 2003 1 km conterminous US Daymet records of gridded daily maximum, minimum, and average temperatures (Thornton *et al*., 1997). As both models were developed using data from temperate deciduous species, we restricted the model comparison with the Eastern Temperate Forest ecoregion.

EPA-852

Lesley Jantarasami/DC/USEPA/US
09/23/2009 12:03 PM

To Carol Holmes
cc Ben DeAngelo, John Hannon, Rona Birnbaum
bcc
Subject Re: Fw: Revised outline for Response to Public Comments doc

Hi Carol,

I've attached the latest version below. [redacted] (b)(5) Deliberative
As you work your way through comments, please let us know what revisions are needed to the outline.

[redacted] (b)(5) Deliberative
CommentResponseOutline_092209.doc

Thanks,

Lesley

Carol Holmes Hi Lesley -- finally out from under report... 09/23/2009 11:51:21 AM

From: Carol Holmes/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA, John Hannon/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 09/23/2009 11:51 AM
Subject: Re: Fw: Revised outline for Response to Public Comments doc

Hi Lesley -- finally out from under reporting rule docs! Which of the documents that you attached is the latest/final outline for the RTC? THANKS

Confidential communication for internal deliberations only; Attorney-client, attorney work product and/or enforcement privilege; Do not distribute outside EPA or DOJ

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Lesley Jantarasami Hi Carol and John, The first attach... 09/10/2009 01:18:12 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA, John Hannon/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA
Date: 09/10/2009 01:18 PM
Subject: Fw: Revised outline for Response to Public Comments doc

Hi Carol and John,

The first attachment below was our initial attempt at combining your legal outline with our categories, drawing directly from the language used in your outline. This document has since been revised (second attachment) to reword section headings and combine or delete sections where appropriate.

As John noted in the conference call today, [redacted] (b)(5) Deliberative

Thanks,

Lesley

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

----- Forwarded by Lesley Jantarasami/DC/USEPA/US on 09/10/2009 12:09 PM -----

From:	Ben DeAngelo/DC/USEPA/US
To:	Rona Birnbaum/DC/USEPA/US@EPA, Carol Holmes/DC/USEPA/US@EPA, John Hannon/DC/USEPA/US@EPA
Cc:	Lesley Jantarasami/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Bill Perkins <perkins.william@epa.gov>, Marcus Sarofim/DC/USEPA/US@EPA, Mike Kolian <kolian.michael@epa.gov>, David Chalmers/DC/USEPA/US@EPA
Date:	08/25/2009 03:51 PM
Subject:	Revised outline for Response to Public Comments doc

Team,

[redacted] (b)(5) Deliberative Please have a close look. May require a brief call to walk through and clarify some items. We'd like to share this with Dina Thursday afternoon.

Thanks!

-Ben and Lesley

[attachment "CommentResponseOutline_LCJ 082509 bjd.doc" deleted by Carol Holmes/DC/USEPA/US]

[attachment "CommentResponseOutline_090309 BJD.doc" deleted by Carol Holmes/DC/USEPA/US]

Benjamin J. DeAngelo
Climate Change Division, Office of Atmospheric Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW (6207J)
Washington, DC 20460

Tel: +1 202-343-9107

Fax: +1 202-343-2202
deangelo.ben@epa.gov

EPA-853

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\05_Outline\RTC Outline -- highlighted BP 092309.doc

(b)(5) Del berative - RTC Outline -- highlighted BP 092309.doc

EPA-854

William Perkins/DC/USEPA/US
09/23/2009 12:13 PM

To Lesley Jantarasami
cc Ben DeAngelo, David Chalmers, Jason Samenow, Jeremy Martinich, Marcus Sarofim, Michael Kolian, Rona Birnbaum
bcc
Subject Re: FYI on our progress

All,

To help me understand where we are currently with draft responses and where we need to go, I highlighted in green the categories that we have now in Quickr on the RTC outline. Perhaps this will be useful to you as well.

Cheers,

Bill

(b)(5) Deliberative

RTC Outline -- highlighted BP 092309.doc

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) (b)(6)

Lesley Jantarasami Hey guys, Rona asked me to pull to... 09/23/2009 10:35:51 AM

From: Lesley Jantarasami/DC/USEPA/US
To: William Perkins/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA
Date: 09/23/2009 10:35 AM
Subject: FYI on our progress

Hey guys,

Rona asked me to pull together all the latest RTC sections posted to Quickr (as of 5:45pm yesterday) to see how it's coming along. (b)(5) Deliberative I've attached the file if you're curious to see how it looks all together (or want to see where the gaps are). However, keep making edits and updates to the individual sections in Quickr, not this document.

Thanks,

Lesley

[attachment "RTC draft 092209.doc" deleted by William Perkins/DC/USEPA/US]

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

EPA-855

Jeremy Martinich/DC/USEPA/US
09/23/2009 12:55 PM

To Carrie Wehling
cc
bcc
Subject Endangerment Comment on SDWA Info Standards

Thanks Carrie and Mindy,

[redacted] (b)(5) Deliberative

Do either of you have some language that we could use for this purpose?

From page 9 of the PDF below:
Obviously, the Endangerment Finding has a "clear and substantial impact" on important public policies. Therefore, the data underlying the decision would be held to the higher standard. Here, EPA falls short, failing to appropriately consider scientific studies or data that have become available since the ANPR was published. As required by the Data Quality Act, EPA issued its own agency-specific guidelines, entitled, Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility and Integrity of Information Disseminated by the Environmental Protection Agency. 15 In conformance with the OMB rules, EPA indicates that information it disseminates, including risk assessments, will be based on best available data and studies. Thus, EPA adopted the objectivity standard from OMB's guidelines, which requires that information be presented in an accurate, clear, complete, unbiased manner, and within a proper context. EPA's quidelines also incorporate the OMB requirement that agencies apply the quality standards specified by Congress in the Safe Drinking Water Act (SDWA) Amendments of 1996. The SDWA standards contain very clear and detailed data quality standards for influential scientific risk assessments. EPA adapts the SDWA standards in its guidelines to require: (A) The substance of the information is accurate, reliable and unbiased. This involves the use of: (i) the best available science and supporting studies conducted in accordance with sound and objective scientific practices, including, when available, peer reviewed science and supporting studies; and (ii) data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies the use of the data). (B) The presentation of information on human health, safety, or environmental risks, consistent with the purpose of the information, is comprehensive, informative, and understandable. In a document made available to the public, EPA specifies: (i) each population addressed by any estimate of applicable human health risk or each risk assessment endpoint, including populations if applicable, addressed by any estimate of applicable ecological risk, (ii) the expected risk or central estimate of human health risk for the specific populations affected or the ecological assessment endpoints including populations if applicable; (iii) each appropriate upper-bound or lower-bound estimate of risk; (iv) each significant uncertainty identified in the process of the assessment of risk and studies that would assist in resolving the uncertainty; and (v) peer-reviewed studies known to the Administrator that support, are directly relevant to, or fail to support any estimate of risk and the methodology used to reconcile inconsistencies in the scientific data.

EPA-HQ-OAR-2009-0171-3764.1.pdf

available at regulations.gov

From page 21 of the PDF below:
It is clear from EPA's IQA guidelines that the Proposal and the TSD are influential scientific information. From the perspective of substance, "objectivity" means that information must be accurate, reliable and unbiased. Influential information regarding risks to health, safety or the environment-like the Proposal-must also conform to standards drawn from the Safe Drinking Water Act (SDWA); i.e., it must be based on "the best available, peer-reviewed science and supporting studies conducted in accordance with sound and objective scientific practices; and... data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies use of the data)." It must also be reproducible. The Proposal and the TSD do not meet this "substantive objectivity" standard. EPA has come to conclusions that are not supported by-or contradict the best available scientific evidence.

EPA-HQ-OAR-2009-0171-3347.1.pdf

available at regulations.gov

Thanks for your help and let me know if you need anything else.
Jeremy

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

Carrie Wehling (b)(5) Deliberative ACP 09/22/2009 09:48:44 PM

From: Carrie Wehling/DC/USEPA/US
To: Mindy Nigoff/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 09/22/2009 09:48 PM
Subject: Re: question

(b)(5) Deliberative ACP

Let me know if you need more from me on this. (b)(5) Deliberative

Thanks.

Carrie

Caroline (Carrie) Wehling
SDWA team leader
Office of General Counsel, Water Law Office
U.S. EPA, Washington, D.C.
Mail Code 2355A
email: wehling.carrie@epa.gov
phone: 202-564-5492
fax: 202-564-5477

Mindy Nigoff Rona- (b)(5) Deliberative ACP 09/21/2009 08:04:06 PM

From: Mindy Nigoff/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Carrie Wehling/DC/USEPA/US@EPA
Date: 09/21/2009 08:04 PM
Subject: Re: question

Rona-

(b)(5) Deliberative ACP

Carrie, do you have anything to add?

I'd be happy to talk with you about it tomorrow. Just let me know.

Thanks,
Mindy

Mindy G. Nigoff
Attorney Adviser
Water Law Office
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2355A)
Washington, DC 20460
Phone (202) 564-0883
Fax (202) 564-5477

Rona Birnbaum hi Mindy, just curious, we got a comme... 09/21/2009 06:18:18 PM

From: Rona Birnbaum/DC/USEPA/US
To: Mindy Nigoff/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA
Date: 09/21/2009 06:18 PM
Subject: question

hi Mindy, just curious, we got a comment on the endangerment proposal below tha (b)(5) Del berative ACP [redacted]

A beginning of a draft response is below, FYI.

Comment:

[redacted] (b)(5) Deliberative [redacted]

Response:

[redacted] (b)(5) Deliberative [redacted]

EPA-856

Jeremy Martinich/DC/USEPA/US
09/23/2009 01:52 PM

To Rona Birnbaum
cc
bcc
Subject Fw: Endangerment Comment on SDWA Info Standards

FYI

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

----- Forwarded by Jeremy Martinich/DC/USEPA/US on 09/23/2009 01:49 PM -----

From: Carrie Wehling/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Cc: Mindy Nigoff/DC/USEPA/US@EPA
Date: 09/23/2009 01:49 PM
Subject: Re: Endangerment Comment on SDWA Info Standards

Jeremy --- (b)(5) Deliberative ACP

[redacted]

Let me know if you need more.
Thanks.
Carrie

Caroline (Carrie) Wehling
SDWA team leader
Office of General Counsel, Water Law Office
U.S. EPA, Washington, D.C.
Mail Code 2355A
email: wehling.carrie@epa.gov
phone: 202-564-5492
fax: 202-564-5477

Jeremy Martinich Thanks Carrie and Mindy, I've pasted... 09/23/2009 12:55:16 PM

From: Jeremy Martinich/DC/USEPA/US
To: Carrie Wehling/DC/USEPA/US@EPA
Date: 09/23/2009 12:55 PM
Subject: Endangerment Comment on SDWA Info Standards

Thanks Carrie and Mindy,

(b)(5) Deliberative

Do either of you have some language that we could use for this purpose?

From page 9 of the PDF below:
Obviously, the Endangerment Finding has a "clear and substantial impact" on important public policies. Therefore, the data underlying the decision would be held to the higher standard. Here, EPA falls short, failing to appropriately consider scientific studies or data that have become available since the ANPR was published. As required by the Data Quality Act, EPA issued its own agency-specific guidelines, entitled, Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility and Integrity of Information Disseminated by the Environmental Protection Agency. 15 In conformance with the OMB rules, EPA indicates that information it disseminates, including risk assessments, will be based on best available data and studies. Thus, EPA adopted the objectivity standard from OMB's guidelines, which requires that information be presented in an accurate, clear, complete, unbiased manner, and within a proper context. EPA's quidelines also incorporate the OMB requirement that agencies apply the quality standards specified by Congress in the Safe Drinking Water Act (SDWA) Amendments of 1996. The SDWA standards contain very clear and detailed data quality standards for influential scientific risk assessments. EPA adapts the SDWA standards in its guidelines to require: (A) The substance of the information is accurate, reliable and unbiased. This involves the use of: (i) the best available science and supporting studies conducted in accordance with sound and objective scientific practices, including, when available, peer reviewed science and supporting studies; and (ii) data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies the use of the data). (B) The presentation of information on human health, safety, or environmental risks, consistent with the purpose of the information, is comprehensive, informative, and understandable. In a document made available to the public, EPA specifies: (i) each population addressed by any estimate of applicable human health risk or each risk assessment endpoint, including populations if applicable, addressed by any estimate of applicable ecological risk, (ii) the expected risk or central estimate of human health risk for the specific populations affected or the ecological assessment endpoints including populations if applicable; (iii) each appropriate upper-bound or lower-bound estimate of risk; (iv) each significant uncertainty identified in the process of the assessment of risk and studies that would assist in resolving the uncertainty; and (v) peer-reviewed studies known to the Administrator that support, are directly relevant to, or fail to support any estimate of risk and the methodology used to reconcile inconsistencies in the scientific data.
[attachment "EPA-HQ-OAR-2009-0171-3764.1.pdf" deleted by Carrie Wehling/DC/USEPA/US]

From page 21 of the PDF below:
It is clear from EPA's IQA guidelines that the Proposal and the TSD are influential scientific information. From the perspective of substance, "objectivity" means that information must be accurate, reliable and unbiased. Influential information regarding risks to health, safety or the environment-like the Proposal-must also conform to standards drawn from the Safe Drinking Water Act (SDWA); i.e., it must be based on "the best available, peer-reviewed science and supporting studies conducted in accordance with sound and objective scientific practices; and... data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies use of the data)." It must also be reproducible. The Proposal and the TSD do not meet this "substantive objectivity" standard. EPA has come to conclusions that are not supported by-or contradict the best available scientific evidence.
[attachment "EPA-HQ-OAR-2009-0171-3347.1.pdf" deleted by Carrie Wehling/DC/USEPA/US]

Thanks for your help and let me know if you need anything else.
Jeremy

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

Carrie Wehling (b)(5) Deliberative ACP 09/22/2009 09:48:44 PM

From: Carrie Wehling/DC/USEPA/US
To: Mindy Nigoff/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 09/22/2009 09:48 PM
Subject: Re: question

(b)(5) Deliberative ACP

Let me know if you need more from me on this. (b)(5) Deliberative

Thanks.

Carrie

Caroline (Carrie) Wehling
SDWA team leader
Office of General Counsel, Water Law Office
U.S. EPA, Washington, D.C.
Mail Code 2355A
email: wehling.carrie@epa.gov
phone: 202-564-5492
fax: 202-564-5477

Mindy Nigoff Rona- (b)(5) Deliberative ACP 09/21/2009 08:04:06 PM

From: Mindy Nigoff/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Carrie Wehling/DC/USEPA/US@EPA
Date: 09/21/2009 08:04 PM
Subject: Re: question

Rona-

(b)(5) Deliberative ACP

Carrie, do you have anything to add?

I'd be happy to talk with you about it tomorrow. Just let me know.

Thanks,
Mindy

Mindy G. Nigoff
Attorney Adviser
Water Law Office
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2355A)
Washington, DC 20460

Phone (202) 564-0883
Fax (202) 564-5477

CONFIDENTIAL communication for internal deliberations only, may contain deliberative, attorney-client, attorney work product, or otherwise privileged material, do not distribute outside EPA or DOJ.

Rona Birnbaum hi Mindy, just curious, we got a comme... 09/21/2009 06:18:18 PM

From: Rona Birnbaum/DC/USEPA/US
To: Mindy Nigoff/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA
Date: 09/21/2009 06:18 PM
Subject: question

hi Mindy, just curious, we got a comment on the endangerment proposal below (b)(5) Deliberative ACP [redacted]

A beginning of a draft response is below, FYI.

Comment:

(b)(5) Deliberative [redacted]

Response:

(b)(5) Deliberative [redacted]

EPA-857

David Chalmers/DC/USEPA/US
09/23/2009 02:23 PM

To Marcus Sarofim
cc
bcc
Subject comments on models in relation to future projections

I'm thinking (b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

[redacted]

[redacted]

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

EPA-858

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\4.1.2.9.1 - Black Carbon 092309.doc

(b)(5) Deliberative - 4.1.2.9.1 - Black Carbon 092309.doc

EPA-859

Marcus Sarofim/DC/USEPA/US
09/23/2009 02:30 PM

To Ben DeAngelo
cc
bcc
Subject beefed up black carbon section

(b)(5) Deliberative

4.1.2.9.1 Black Carbon

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

(b)(5) Deliberative

Response:

(b)(5) Deliberative

EPA-860

Marcus Sarofim/DC/USEPA/US
09/23/2009 03:23 PM

To Michael Kolian
cc
bcc
Subject Re: palaeo

Looks good to me. (b)(5) Deliberative

-Marcus

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

Michael Kolian Do you mind reviewing this response to... 09/23/2009 03:07:07 PM

From: Michael Kolian/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA
Date: 09/23/2009 03:07 PM
Subject: palaeo

Do you mind reviewing this response too? I owe ya.

Comment: (b)(5) Deliberative

Response: (b)(5) Deliberative

(b)(5) Deliberative

EPA-861

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\2.4.1 -- Climate Models.doc

(b)(5) Deliberative - 2.4.1 -- Climate Models.doc

EPA-862

William Perkins/DC/USEPA/US
09/23/2009 05:31 PM

To Michael Kolian
cc
bcc
Subject Re: 3697_CP

Mike,

Sure! They are:

(b)(5) Deliberative [redacted]

Cheers,

Bill

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) (b)(6) [redacted]

Michael Kolian Bill can you tell the categories the num... 09/23/2009 03:24:58 PM

From: Michael Kolian/DC/USEPA/US
To: Bill Perkins <perkins.william@epa.gov>
Date: 09/23/2009 03:24 PM
Subject: 3697_CP

Bill can you tell the categories the number is in?

Appreciate it. Mike

EPA-863

Lesley Jantarasami
04/01/2010 03:47 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\02_Compiled\compile 1\Agricultural Impacts comment response 9_18_09 merge.doc

(b)(5) Deliberative - Agricultural Impacts comment response 9_18_09 merge.doc

EPA-864

Matthew Menne
<Matthew.Menne@noaa.gov>
09/23/2009 06:16 PM

To Jason Samenow
cc "Claude.N.Williams", "jay.lawrimore"
bcc
Subject Re: [Fwd: noaa ushcn vs nasa giss]

Jason,

No problem. I agree (b)(5) Deliberative

(b)(5) Deliberative

.

Matt

Samenow.Jason@epamail.epa.gov said the following on 9/23/2009 3:24 PM:
> By the way, my rationale (b)(5) Deliberative

>
>
>
>
> From: Jason Samenow/DC/USEPA/US
>
> To: Matthew Menne <Matthew.Menne@noaa.gov>
>
> Cc: "Claude.N.Williams" <Claude.N.Williams@noaa.gov>,
"jay.lawrimore" <Jay.Lawrimore@noaa.gov>
>
> Date: 09/23/2009 03:20 PM
>
> Subject: Re: [Fwd: noaa ushcn vs nasa giss]
>
>
>
>
>
> Matt-- I think -- (b)(5) Deliberative

>
> Also, can you do me a favor-- can you (b)(5) Deliberative

> (b)(5) Deliberative
>
> Thanks,
> Jason
>
>
>
>
>
> From: Matthew Menne <Matthew.Menne@noaa.gov>
>
> To: Jason Samenow/DC/USEPA/US@EPA
>
> Cc: "Claude.N.Williams" <Claude.N.Williams@noaa.gov>,
"jay.lawrimore" <Jay.Lawrimore@noaa.gov>
>
> Date: 09/23/2009 02:12 PM
>
> Subject: Re: [Fwd: noaa ushcn vs nasa giss]
>
>
>
>
>
>
> Thanks Jason.
>
> Yes, (b)(5) Deliberative Do you think that
> you have enough information to respond to the comments?
>
> BTW, I've did a little more investigating and it does really look like
> (b)(5) Deliberative
>
> Matt
>
> Samenow.Jason@epamail.epa.gov said the following on 9/22/2009 8:03 PM:
> (b)(5) Deliberative

(b)(5) Delibera ive

Jason

From: Matthew Menne <Matthew.Menne@noaa.gov>

To: Jason Samenow/DC/USEPA/US@EPA

Cc: "Claude.N.Williams" <Claude.N.Williams@noaa.gov>, "jay.lawrimore" <Jay.Lawrimore@noaa.gov>

Date: 09/22/2009 07:30 PM

Subject: Re: [Fwd: noaa ushcn vs nasa giss]

OK, I've attached the USHCN data. I used (b)(5) Deliberative

Matt

Samenow.Jason@epamail.epa.gov said the following on 9/22/2009 7:21 PM:

> This is really helpful. Can you send me (b)(5) Deliberative
>
> Thanks so much.
>
> Jason

> From: Matthew Menne <Matthew.Menne@noaa.gov>
>
> To: "jay.lawrimore" <Jay.Lawrimore@noaa.gov>
>
> Cc: Jason Samenow/DC/USEPA/US@EPA, "Claude.N.Williams" <Claude.N.Williams@noaa.gov>
>
> Date: 09/22/2009 07:12 PM
>
> Subject: Re: [Fwd: noaa ushcn vs nasa giss]

Jason,

Here are some responses to your questions:

1) (b)(5) Deliberative

> >

(b)(5) Deliberative

> >

2) (b)(5) Deliberative

> >

(b)(5) Deliberative

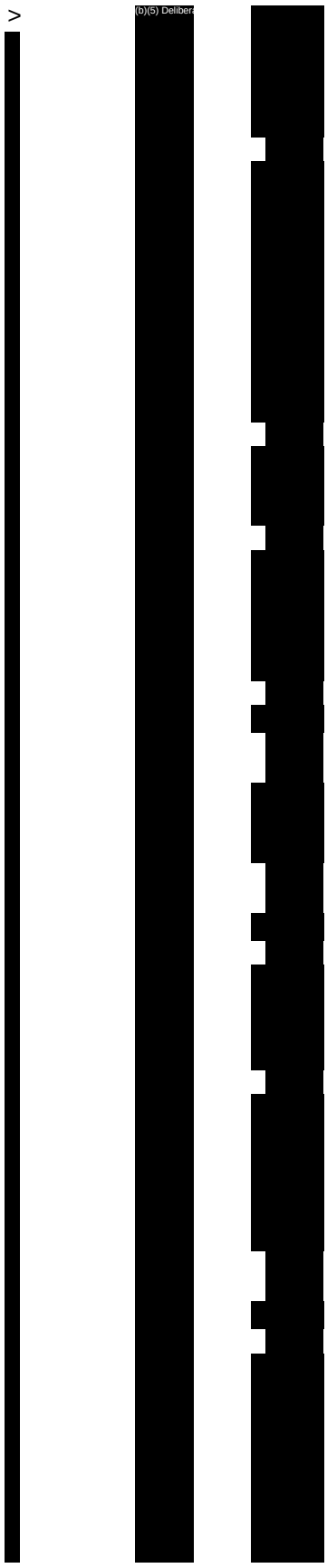
> > >

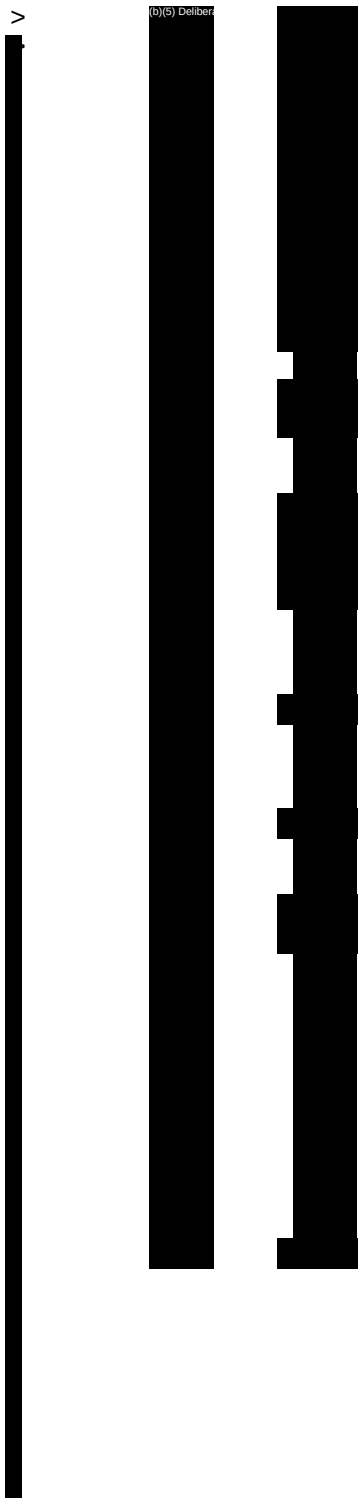
3) (b)(5) Deliberative

> I would reference that article if anyone wants further
> information.
>
> -Matt
>
> jay.lawrimore said the following on 9/22/2009 2:02 PM:
> Jason, thanks. Matt and I will provide some verbage
> for your
> response.
>
> -------- Original Message --------
>
> Subject: noaa ushcn vs nasa giss
>
>
> Date: Tue, 22 Sep 2009 12:11:08 -0400
>
> From: Samenow.Jason@epamail.epa.gov
>
> To: jay.lawrimore
> <Jay.Lawrimore@noaa.gov>
>
>
>
>
> Jay--
>
>
> (b)(5) Deliberative
>

> (b)(5) Deliberative

> So our questions are:
>
> 1) (b)(5) Deliberative
> 2) (b)(5) Deliberative
>
> 3) (b)(5) Deliberative
>
> Thanks for your help...
>
> Jason
>
> (See attached file: nasa-noaa-us-trend-compare.xls)
>
> (b)(5) Deliber


(b)(5) Deliber


(b)(5) Deliber

EPA-865

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\4.1.2.9.1 - Black Carbon 092309 BJD.doc

(b)(5) Deliberative - 4.1.2.9.1 - Black Carbon 092309 BJD.doc

EPA-866

Doug Grano
03/24/2010 11:33 AM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\dgrano\My Documents\WP\Climate\Rulemaking\Endangerment\Comment-response\4.1.2.9.1 - Black Carbon 092309 BJD.doc

(b)(5) Deliberative - 4.1.2.9.1 - Black Carbon 092309 BJD.doc

EPA-867

Ben DeAngelo/DC/USEPA/US
09/23/2009 07:39 PM

To Doug Grano
cc Bryan Bloomer, Dale Evarts, Darrell Winner, Erika Sasser, John Dawson, Marcus Sarofim
bcc Rona Birnbaum
Subject Re: Continued discussion on response to public comments re: TSD AQ

Doug et al,

Here are draft responses to comments on BC. At least you and Darrell and a few others should have access to our database that contains all the original comments (this doc contains summaries of those comments).

Yes, comments/feedback welcome.

-Ben

(b)(5) Deliberative

4.1.2.9.1 - Black Carbon 092309 BJD.doc

Doug Grano Ben-- In addition to the ozone/PM com... 09/23/2009 08:47:38 AM

From: Doug Grano/RTP/USEPA/US
To: Ben DeAngelo/DC/USEPA/US@EPA
Cc: Bryan Bloomer/DC/USEPA/US@EPA, Darrell Winner/DC/USEPA/US@EPA, John Dawson/DC/USEPA/US@EPA, Dale Evarts/RTP/USEPA/US@EPA, Erika Sasser/RTP/USEPA/US@EPA
Date: 09/23/2009 08:47 AM
Subject: Re: Continued discussion on response to public comments re: TSD AQ

Ben--
In addition to the ozone/PM comments on the air quality section, could we also look at comments/draft responses relating to black carbon? Thanks
--Doug

EPA-868

Lesley Jantarasami/DC/USEPA/US
09/24/2009 09:48 AM

To Rona Birnbaum
cc
bcc
Subject RTC draft

Hi Rona,

Here is the draft compilation, including the Introduction.

(b)(5) Deliberative [redacted]
RTC draft 092409.doc

Thanks,

Lesley

EPA-869

Lesley Jantarasami
04/01/2010 03:48 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\03_Other\SLR comment from OGC.doc

(b)(5) Deliberative - SLR comment from OGC.doc

EPA-870

Lesley Jantarasami/DC/USEPA/US
09/24/2009 11:30 AM

To Jeremy Martinich
cc
bcc
Subject OGC comment on SLR

Did you see this comment from OGC about a comment from the Sea Level Rise section? Wanted to make sure it got addressed in the latest version.

(b)(5) Deliberative

SLR comment from OGC.doc

Thanks!

Lesley

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

EPA-871

Lesley Jantarasami
04/01/2010 03:47 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\02_Compiled\compile 1\2.1.4 - Adaptation and Mitigation 092409.doc

(b)(5) Deliberative [redacted] - 2.1.4 - Adaptation and Mitigation 092409.doc

EPA-872

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft 092409.doc

(b)(5) Deliberative [redacted] - RTC draft 092409.doc

EPA-873

Lesley Jantarasami/DC/USEPA/US
09/24/2009 11:37 AM

To John Hannon
cc
bcc
Subject adaptation and mitigation section

Hi John,

Here is our draft section on adaptation and mitigation [redacted] (b)(5) Deliberative [redacted]

Thanks,

Lesley

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

(b)(5) Deliberative [redacted]
2.1.4 - Adaptation and Mitigation 092409.doc

EPA-874

Jeremy Martinich/DC/USEPA/US
09/24/2009 11:52 AM

To Lesley Jantarasami
cc
bcc
Subject Re: OGC comment on SLR

Thanks Lesley.

Yes, I've got this one on the list...

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

Lesley Jantarasami Did you see this comment from OG... 09/24/2009 11:30:42 AM

From: Lesley Jantarasami/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Date: 09/24/2009 11:30 AM
Subject: OGC comment on SLR

Did you see this comment from OGC about a comment from the Sea Level Rise section? Wanted to make sure it got addressed in the latest version.

[attachment "SLR comment from OGC.doc" deleted by Jeremy Martinich/DC/USEPA/US]

Thanks!

Lesley

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

EPA-875

Michael Kolian/DC/USEPA/US
09/24/2009 12:00 PM

To Ben DeAngelo, Marcus Sarofim
cc
bcc
Subject air quality

Ben,
FYI: (b)(5) Deliberative

Let me know if you agree then we can make the adjustments.

Comment: (b)(5) Deliberative

(b)(5) Deliberative

RTC AQ 9-17.doc

EPA-876

Jeremy Martinich/DC/USEPA/US
09/24/2009 12:14 PM

To Lesley Jantarasami
cc
bcc
Subject Sections I mentioned

(b)(5) Deliberative

Section 2.2 General Comments on TSD.doc

(b)(5) Deliberative

Section 2.1.3 NCEE - Consideration of Other Scientific Assessments.doc

****

Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

EPA-877

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.5.5 Water Resources.doc

(b)(5) Deliberative - 2.5.5 Water Resources.doc

EPA-878

Lesley Jantarasami/DC/USEPA/US
09/24/2009 02:36 PM

To Marcus Sarofim, Jeremy Martinich, Jason Samenow, David Chalmers
cc William Perkins
bcc
Subject more comments for redistribution

Hey guys,

Attached is a list of more comments for redistribution (your name, followed by all applicable comments and comment bubbles to indicate which section they should go into). In most cases, (b)(5) Deliberative

Jason - (b)(5) Deliberative

(b)(5) Deliberative

Redistributed Comments 092409 - NCEE and Petition.doc

Please let me know if you have questions - thanks!

Lesley

EPA-879

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft 092409 RB.doc

(b)(5) Deliberative - RTC draft 092409 RB.doc

EPA-880

Jeremy Martinich/DC/USEPA/US
09/24/2009 03:23 PM

To Lesley Jantarasami
cc
bcc
Subject Water section

Thanks for looking at this. It needs some additional work (b)(5) Deliberative but it is hopefully worthy of posting on Quickr after your review...

(b)(5) Deliberative

Section 2.5.5 Water Resources.doc

Thanks,
Jeremy

EPA-881

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.4.3 Validity of Future Temp. Projections, DBC, 092409.doc

(b)(5) Deliberative - 2.4.3 Validity of Future Temp. Projections, DBC, 092409.doc

EPA-882

Rona Birnbaum/DC/USEPA/US
09/24/2009 03:33 PM

To Lesley Jantarasami
cc Jeremy Martinich
bcc
Subject comments

as I'm reading through I cannot help but begin to make some comments in track changes. (b)(5) Deliberative

Also, Lesley, for the copy we give to Dina tomorrow, can you also add in the table of contents at the beginning?

(b)(5) Deliberative

RTC draft 092409.doc

EPA-883

David Chalmers/DC/USEPA/US
09/24/2009 03:33 PM

To Lesley Jantarasami
cc
bcc
Subject time for a quick review?

Hi Lesley,

(b)(5) Deliberative

If you're slammed please don't worry about it as I know the top priority right now is getting drafts finished.

Thanks!
David

(b)(5) Deliberative

2.4.3 Validity of Future Temp. Projections, DBC, 092409.doc

EPA-884

William Perkins/DC/USEPA/US
09/24/2009 03:38 PM

To David Chalmers
cc Lesley Jantarasami
bcc
Subject Fw: comments from Marcus for your sections

David: FYI, [redacted] (b)(5) Deliberative

Lesley: [redacted] (b)(5) Deliberative

Cheers,

Bill

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) [redacted] (b)(6)

----- Forwarded by William Perkins/DC/USEPA/US on 09/24/2009 03:37 PM -----

From: Lesley Jantarasami/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 09/23/2009 10:12 AM
Subject: comments from Marcus for your sections

Jason, the attached comment summaries/responses [redacted] (b)(5) Deliberative I noted where I think they should go in comment bubbles. Please edit the responses as you see fit, or combine with text you've already drafted.

Bill, I also noted in the comment bubbles where the comment came from in the ERG database, so that ERG can move copies of the original comment into the new sections.

Thanks!

Lesley

[redacted] (b)(5) Del berative
New Comments for Jason.doc

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

EPA-885

Jason Samenow/DC/USEPA/US
09/24/2009 04:23 PM

To William Perkins, Ben DeAngelo, David Chalmers, Jeremy Martinich, Lesley Jantarasami, Marcus Sarofim, Michael Kolian, Rona Birnbaum
cc
bcc
Subject TSD -- and response to comments

Team--

(b)(5) Deliberative

(b)(5) Deliberative

I attach the latest version of the TSD which includes the USP updates and my partial updates based on response to comments so far. I will merge any changes anyone wants to make into this version.

Thanks...

Jason

(b)(5) Deliberative

TSD Endangerment USP - revisions master 092409.doc

EPA-886

William Perkins/DC/USEPA/US
09/24/2009 04:28 PM

To Jason Samenow
cc
bcc
Subject Re: TSD -- and response to comments

Jason,

Thank you for this opportunity.

In the spirit of leaving nothing hanging in case I get hit by a bus on the way home, I made one small change (b)(5) Deliberative (enclosed, highlighted for your easy reference). Thank you sir.

Cheers,

Bill

(b)(5) Deliberative

TSD Endangerment -- BP additional adds in green.doc

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) (b)(6)

Jason Samenow Team-- (b)(5) Deliberative 09/24/2009 04:23:53 PM

From: Jason Samenow/DC/USEPA/US
To: William Perkins/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 09/24/2009 04:23 PM
Subject: TSD -- and response to comments

Team--

(b)(5) Deliberative

(b)(5) Deliberative

I attach the latest version of the TSD which includes the USP updates and my partial updates based on

response to comments so far. I will merge any changes anyone wants to make into this version.

Thanks...

Jason

[attachment "TSD Endangerment USP - revisions master 092409.doc" deleted by William Perkins/DC/USEPA/US]

EPA-887

William Perkins/DC/USEPA/US
09/24/2009 05:15 PM

To Lesley Jantarasami
cc
bcc
Subject Re: more redistribution

Lesley,

Thank you. With regard to the question in your first comment in the document, [redacted] (b)(5) Deliberative [redacted]

Cheers,

Bill

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) [redacted] (b)(6)

Lesley Jantarasami Bill, Attached is another set of com... 09/22/2009 05:24:06 PM

From: Lesley Jantarasami/DC/USEPA/US
To: William Perkins/DC/USEPA/US@EPA
Date: 09/22/2009 05:24 PM
Subject: more redistribution

Bill,

Attached is another set of comments that I'm redistributing to other parts of the RTC doc.

Thanks!

Lesley

[attachment "2.5 - Impacts and Risks to Public Health and Welfare 092209 redistributed.doc" deleted by William Perkins/DC/USEPA/US]

EPA-888

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\2.4.8 -- Abrupt Climate Change.doc

(b)(5) Deliberative - 2.4.8 -- Abrupt Climate Change.doc

EPA-889

David Chalmers/DC/USEPA/US
09/24/2009 05:47 PM

To Jeremy Martinich
cc
bcc
Subject only if you have time

Thanks dude. [redacted] (b)(5) Deliberative [redacted]

Have a great weekend.

[redacted] (b)(5) Deliberative

2.4.3 Validity of Future Temp. Projections, DBC, 092409.doc

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

EPA-890

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\Comments 7.7.ppt

(b)(5) Deliberative - Comments 7.7.ppt

EPA-891

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft for Dina 092409.doc

(b)(5) Deliberative - RTC draft for Dina 092409.doc

EPA-892

Lesley Jantarasami/DC/USEPA/US
09/24/2009 07:18 PM

To Rona Birnbaum, Ben DeAngelo, Jason Samenow
cc
bcc
Subject RTC doc compiled

Hello,

Here is the next iteration of the RTC doc - [redacted]. Sorry to miss the meeting tomorrow, but I look forward to getting caught up on everything on Monday.

Thanks,

Lesley

[redacted]
RTC draft for Dina 092409.doc

EPA-893

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\RTC draft for Dina 092409.doc

(b)(5) Deliberative - RTC draft for Dina 092409.doc

EPA-894

Michael Kolian/DC/USEPA/US
09/25/2009 11:08 AM

To Lesley Jantarasami
cc
bcc
Subject validity of observed/measured data

Lesley,

(b)(5) Deliberative I wanted to send it to you first to review before it goes to those it needs to. I am still working on three more comments but wanted to get this to you now. Let me know when you've had a chance to look at it. Note: all but about three I have provided a response for.

Cheers,
Mike

(b)(5) Deliberative

Temperature validity comment summary 9_25_09_merge.doc

EPA-895

William Perkins/DC/USEPA/US
09/25/2009 11:47 AM

To Lesley Jantarasami
cc
bcc
Subject Fw: more comments for redistribution

Lesley,

I think [redacted] (b)(5) Deliberative [redacted] Please let me know if you don't think that that's a good approach otherwise we'll go with it.

Cheers,

Bill

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) [redacted] (b)(6)

----- Forwarded by William Perkins/DC/USEPA/US on 09/25/2009 11:45 AM -----

From: Jason Samenow/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 09/24/2009 04:06 PM
Subject: Re: more comments for redistribution

Lesley-- Thanks for generating this. I have some different thoughts on where the comments should go in a few instances. See attached.

Jason

[redacted] (b)(5) Deliberative

Redistributed Comments 092409 - NCEE and Petition JPS.doc

Lesley Jantarasami Hey guys, Attached is a list of more... 09/24/2009 02:36:58 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA
Cc: William Perkins/DC/USEPA/US@EPA
Date: 09/24/2009 02:36 PM
Subject: more comments for redistribution

Hey guys,

Attached is a list of more comments for redistribution (your name, followed by all applicable comments and comment bubbles to indicate which section they should go into). In most cases, (b)(5) Deliberative

Jason - (b)(5) Deliberative

[attachment "Redistributed Comments 092409 - NCEE and Petition.doc" deleted by Jason Samenow/DC/USEPA/US]

Please let me know if you have questions - thanks!

Lesley

EPA-896

Doug Grano/RTP/USEPA/US
09/25/2009 12:45 PM

To Ben DeAngelo
cc Bryan Bloomer, Dale Evarts, Darrell Winner, Erika Sasser, John Dawson, Marcus Sarofim
bcc
Subject Re: Continued discussion on response to public comments re: TSD AQ

Ben--
The comment-responses on black carbon look good to me.
--Doug

Ben DeAngelo Doug et al, Here are draft responses to... 09/23/2009 07:39:24 PM

From: Ben DeAngelo/DC/USEPA/US
To: Doug Grano/RTP/USEPA/US@EPA
Cc: Bryan Bloomer/DC/USEPA/US@EPA, Dale Evarts/RTP/USEPA/US@EPA, Darrell Winner/DC/USEPA/US@EPA, Erika Sasser/RTP/USEPA/US@EPA, John Dawson/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA
Date: 09/23/2009 07:39 PM
Subject: Re: Continued discussion on response to public comments re: TSD AQ

Doug et al,

Here are draft responses to comments on BC. At least you and Darrell and a few others should have access to our database that contains all the original comments (this doc contains summaries of those comments).

Yes, comments/feedback welcome.

-Ben

[attachment "4.1.2.9.1 - Black Carbon 092309 BJD.doc" deleted by Doug Grano/RTP/USEPA/US]

Doug Grano Ben-- In addition to the ozone/PM com... 09/23/2009 08:47:38 AM

From: Doug Grano/RTP/USEPA/US
To: Ben DeAngelo/DC/USEPA/US@EPA
Cc: Bryan Bloomer/DC/USEPA/US@EPA, Darrell Winner/DC/USEPA/US@EPA, John Dawson/DC/USEPA/US@EPA, Dale Evarts/RTP/USEPA/US@EPA, Erika Sasser/RTP/USEPA/US@EPA
Date: 09/23/2009 08:47 AM
Subject: Re: Continued discussion on response to public comments re: TSD AQ

Ben--
In addition to the ozone/PM comments on the air quality section, could we also look at comments/draft responses relating to black carbon? Thanks
--Doug

EPA-897

William Perkins/DC/USEPA/US
09/25/2009 01:40 PM

To hqchemlibraries
cc Genita Joyner
bcc
Subject Journal articles requested

Genita,

As discussed -- thank you. Please use the same approach as on the books -- (b)(5) Deliberative

Sincerely,

Bill

(b)(5) Deliberative

Articles needed for EPA library 092509.xls

Bill Perkins
Climate Change Adaptation Analyst
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(C) (b)(6)

EPA-898

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\2.1.5, JPS + DBC + BJD, 092409.doc

(b)(5) Deliberative - 2.1.5, JPS + DBC + BJD, 092409.doc

EPA-899

Ben DeAngelo/DC/USEPA/US
09/25/2009 02:16 PM

To David Chalmers
cc Lesley Jantarasami
bcc
Subject edited version of 2.1.5 - Consideration of net effects

(b)(5) Deliberative

2.1.5, JPS + DBC + BJD, 092409.doc

David, I did some editing of this but thanks for providing me with something to work with. Also added this to quicker and could add it to the compilation we'll be showing Dina this afternoon.

-Ben

Benjamin J. DeAngelo
Climate Change Division, Office of Atmospheric Programs
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deangelo.ben@epa.gov

EPA-900

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\RTC AQ 9-21.doc

(b)(5) Deliberative - RTC AQ 9-21.doc

EPA-901

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\RTC draft for Dina 092509.doc

(b)(5) Deliberative [redacted] - RTC draft for Dina 092509.doc

EPA-902

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft for Dina 092509.doc

(b)(5) Deliberative - RTC draft for Dina 092509.doc

EPA-903

Ben DeAngelo/DC/USEPA/US
09/25/2009 05:43 PM

To Dina Kruger
cc birnbaum.rona, Jason Samenow, Lesley Jantarasami
bcc
Subject draft compilation of response to comments as of 9/25, 5pm

(b)(5) Deliberative
RTC draft for Dina 092509.doc

As well as draft outline of final finding and issues for option selection:

(b)(5) Deliberative
Draft outline Final Finding 1.doc

(b)(5) Deliberative
Draft option selection issues - endangerment.doc

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EPA-904

Lesley Jantarasami/DC/USEPA/US
09/28/2009 09:08 AM

To William Perkins
cc
bcc
Subject Re: Fw: more comments for redistribution

Sounds good to me!

Lesley

William Perkins Lesley, I think (b)(5) deliberative 09/25/2009 11:47:50 AM

From: William Perkins/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 09/25/2009 11:47 AM
Subject: Fw: more comments for redistribution

Lesley,

I think (b)(5) Deliberative Please let me know if you don't think that that's a good approach otherwise we'll go with it.

Cheers,

Bill

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) (b)(6)

----- Forwarded by William Perkins/DC/USEPA/US on 09/25/2009 11:45 AM -----

From: Jason Samenow/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 09/24/2009 04:06 PM
Subject: Re: more comments for redistribution

Lesley-- Thanks for generating this. I have some different thoughts on where the comments should go in a few instances. See attached.

Jason

[attachment "Redistributed Comments 092409 - NCEE and Petition -JPS.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

Lesley Jantarasami Hey guys, Attached is a list of more... 09/24/2009 02:36:58 PM

From:	Lesley Jantarasami/DC/USEPA/US
To:	Marcus Sarofim/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA
Cc:	William Perkins/DC/USEPA/US@EPA
Date:	09/24/2009 02:36 PM
Subject:	more comments for redistribution

Hey guys,

Attached is a list of more comments for redistribution (your name, followed by all applicable comments and comment bubbles to indicate which section they should go into). In most cases, (b)(5) Deliberative [redacted]

Jason - (b)(5) Deliberative [redacted]

[attachment "Redistributed Comments 092409 - NCEE and Petition.doc" deleted by Jason Samenow/DC/USEPA/US]

Please let me know if you have questions - thanks!

Lesley

EPA-905

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\Temperature validity comment summary 9_25_09_merge.doc

(b)(5) Deliberative - Temperature validity comment summary 9_25_09_merge.doc

EPA-906

William Perkins/DC/USEPA/US
09/28/2009 11:25 AM

To Jason Samenow, Marcus Sarofim, Michael Kolian, David Chalmers, Jeremy Martinich, Ben DeAngelo
cc Lesley Jantarasami, Rona Birnbaum
bcc
Subject Heads-up: small number of additional comments coming your way

Endangerment team,

(b)(5) Deliberative

Thank you for your time and attention and please let me know if you have any questions or concerns.

Cheers,

Bill

Bill Perkins
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(C) (b)(6)

EPA-907

Lesley Jantarasami/DC/USEPA/US
09/28/2009 11:49 AM

To Michael Kolian
cc
bcc
Subject Re: redistrib to Section 2.2.2

Sorry!

(b)(5) Deliberative

Comments for 2.2.2 from 9.5.doc

Michael Kolian I missed the attachment 09/28/2009 11:45:49 AM

From: Michael Kolian/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 09/28/2009 11:45 AM
Subject: Re: redistrib to Section 2.2.2

I missed the attachment

Lesley Jantarasami Hi Mike, Here are the responses to... 09/28/2009 11:00:43 AM

From: Lesley Jantarasami/DC/USEPA/US
To: Mike Kolian <kolian.michael@epa.gov>
Cc: William Perkins/DC/USEPA/US@EPA
Date: 09/28/2009 11:00 AM
Subject: redistrib to Section 2.2.2

Hi Mike,

Here are the responses to be redistributed to Section 2.2.2 from ERG category 9.5.

Thanks,

Lesley

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

EPA-908

William Perkins/DC/USEPA/US
09/28/2009 12:03 PM

To Marcus Sarofim
cc
bcc
Subject New categorized comments

Marcus,

Per earlier email.

Cheers,

Bill

(b)(5) Deliberative

Comment Code 9.7.1 - Models.doc

(b)(5) Deliberative

Comment Code 9.5.1 - Greenhouse gas emissions and concentrations.doc

(b)(5) Deliberative

Comment Code 9.5.1.1 - Radiative Forcing.doc

(b)(5) Del berative

Comment Code 9.6.2.2 - Solar Irradiance.doc

(b)(5) Deliberative

Comment Code 9.6.2.3 - Greenhouse Gas Effect Does Not Exist.doc

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(C) (b)(6)

EPA-909

William Perkins/DC/USEPA/US
09/28/2009 12:05 PM

To Michael Kolian
cc
bcc
Subject Newly categorized comments

Mike,

Per earlier email.

Cheers,

Bill

(b)(5) Deliberative

Comment Code 9.7.8 - Human Health.doc

Bill Perkins
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(C) (b)(6)

EPA-910

William Perkins/DC/USEPA/US
09/28/2009 12:06 PM

To Jason Samenow
cc
bcc
Subject new categorized comment

Jason,

Per earlier email.

Cheers,

Bill

(b)(5) Deliberative

Comment Code 9.5.2 - Temperature.doc

Bill Perkins
Climate Change Adaptation Analyst
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(F) 202.343.2202
(C) (b)(6)

EPA-911

William Perkins/DC/USEPA/US
09/28/2009 12:06 PM

To Jeremy Martinich
cc
bcc
Subject new categorized comment

Jeremy,

Per earlier email.

Cheers,

Bill

(b)(5) Deliberative

Comment Code 9.3 - Adherence to the Data Quality Act.doc

(b)(5) Deliberative

Comment Code 9.2 - IPCC and CCSP Reports as the Scientific Basis.doc

(b)(5) Deliberative

Comment Code 9.7.12 - Water Resources.doc

Bill Perkins
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(C) (b)(6)

EPA-912

William Perkins/DC/USEPA/US
09/28/2009 12:07 PM

To Lesley Jantarasami
cc
bcc
Subject new categorized comment

Lesley,

Per earlier email.

Cheers,

Bill

(b)(5) Deliberative

Comment Code 9.5.8 - Effects on Society.doc

Bill Perkins
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Climate Science and Impacts Branch
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(C) (b)(6)

EPA-913

Michael Kolian/DC/USEPA/US
09/28/2009 12:32 PM

To Jason Samenow
cc Bill Perkins, Lesley Jantarasami
bcc
Subject comments for 2.2.2

Jason,
Here are completed comments/responses for 2.2.2 (temperature observed) that were in 9.5 (validity of observed/measured data).

These should be added/folded in as appropriate.

Cheers,
Mike

(b)(5) Deliberative

Comments for 2.2.2 from 9.5_kolian.doc

Michael Kolian, USEPA
Office of Atmospheric Programs
Climate Change Division
1200 Pennsylvania Avenue, NW (6207J)
Washington, DC 20460
ph#: 202-343-9261

EPA-914

Lesley Jantarasami/DC/USEPA/US
09/28/2009 12:35 PM

To Marcus Sarofim
cc
bcc
Subject double check category assignments

Hi Marcus,

Once again, can you let me know if you agree with the new categories I've assigned to the attached comments? (b)(5) Deliberative

Thanks so much,

Lesley

(b)(5) Deliberative

Redistrib 092809 Section9.5.doc

EPA-915

Ben DeAngelo/DC/USEPA/US
09/28/2009 01:11 PM

To Susan Solomon
cc
bcc
Subject Fw: Update on EPA endangerment process

Dear Susan,

Embarrassingly used your wrong email once again. Update on the status of endangerment below...

all the best,

-Ben

----- Forwarded by Ben DeAngelo/DC/USEPA/US on 09/28/2009 01:08 PM -----

From: Virginia Burkett <virginia_burkett@usgs.gov>
To: Ben DeAngelo/DC/USEPA/US@EPA
Cc: Anthony Janetos <anthony.janetos@pnl.gov>, Rona Birnbaum/DC/USEPA/US@EPA, Anne Grambsch/DC/USEPA/US@EPA, gschmidt@giss.nasa.gov, "Hatfield, Jerry" <Jerry.Hatfield@ARS.USDA.GOV>, Dina Kruger/DC/USEPA/US@EPA, "Linda Joyce" <ljoyce@fs.fed.us>, "McGeehin, Mike (CDC/CCEHIP/NCEH)" <mam7@CDC.GOV>, "Phil DeCola" [redacted] (b)(6) Jason Samenow/DC/USEPA/US@EPA, "Susan Solomon" <ssolomon@al.noaa.gov>, "Thomas R. Karl" <Thomas.R.Karl@noaa.gov>, "Tom Wilbanks" <wilbankstj@ornl.gov>, "Emanuel, William R" <William.Emanuel@pnl.gov>
Date: 09/28/2009 10:57 AM
Subject: Re: Update on EPA endangerment process

Dear Ben, I am also happy to help. As early as you can, please let us know the time frame for the final review.
Virginia

From: DeAngelo.Ben@epamail.epa.gov

To: Anthony Janetos <anthony.janetos@pnl.gov>, Grambsch.Anne@epamail.epa.gov, <gschmidt@giss.nasa.gov>, "Hatfield, Jerry" <Jerry.Hatfield@ARS.USDA.GOV>, "Linda Joyce" <ljoyce@fs.fed.us>, "McGeehin, Mike (CDC/CCEHIP/NCEH)" <mam7@CDC.GOV>, "Phil DeCola" [redacted] (b)(6), "Susan Solomon" <ssolomon@al.noaa.gov>, "Thomas R. Karl" <Thomas.R.Karl@noaa.gov>, "Virginia Burkett" <virginia_burkett@usgs.gov>, "Tom Wilbanks" <wilbankstj@ornl.gov>, "Emanuel, William R" <William.Emanuel@pnl.gov>

Cc: Kruger.Dina@epamail.epa.gov, Birnbaum.Rona@epamail.epa.gov, Samenow.Jason@epamail.epa.gov

Date: 09/23/2009 07:18 PM

Subje: Update on EPA endangerment process

ct
:

Dear colleagues,

We have been sifting through and responding to numerous (~400,00) public comments EPA received on its proposed endangerment finding and the underlying technical support document (TSD), which you all reviewed. We have been editing and updating the TSD in light of major new scientific assessments (e.g., USGCRP "Global Climate Change Impacts in the United States") and in response to certain public comments that warrant a change to the TSD. We are maintaining our approach that the TSD should be based primarily on major assessment reports such as those from IPCC and USGCRP/CCSP, rather than trying to conduct a new assessment that puts every new paper in the appropriate context.

We will be heading towards a final review of the TSD to accompany a final finding by EPA. There will also be a separate document that details our responses to all significant public comments. So I would like to give you the heads-up for now that we will ask for your final review of the updated TSD (with track changes to easily identify what's new), and we may also ask that you review a limited set of our responses to public comments which require some technical detail.

I do not yet have a specific date when we may be sending the TSD plus any of our responses, but likely to be within the month or so. I hope you will be able to provide a final review; your reviews so far have been extremely helpful to this process.

If there are any questions in the meantime please let me know.

All the best and will be in touch soon,

-Ben

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EPA-916

Lesley Jantarasami/DC/USEPA/US
09/28/2009 01:12 PM

To Marcus Sarofim
cc
bcc
Subject Re: double check category assignments

Thanks!

(b)(5) Deliberative

Best,

Lesley

Marcus Sarofim Hi Lesley, (b)(5) Deliberative 09/28/2009 12:51:45 PM

From: Marcus Sarofim/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 09/28/2009 12:51 PM
Subject: Re: double check category assignments

Hi Lesley,

(b)(5) Deliberative

-Marcus

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

Lesley Jantarasami Hi Marcus, Once again, can you let... 09/28/2009 12:35:47 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA
Date: 09/28/2009 12:35 PM
Subject: double check category assignments

Hi Marcus,

Once again, can you let me know if you agree with the new categories I've assigned to the attached comments? [redacted] (b)(5) Deliberative [redacted]

Thanks so much,

Lesley

[attachment "Redistrib 092809 Section9.5.doc" deleted by Marcus Sarofim/DC/USEPA/US]